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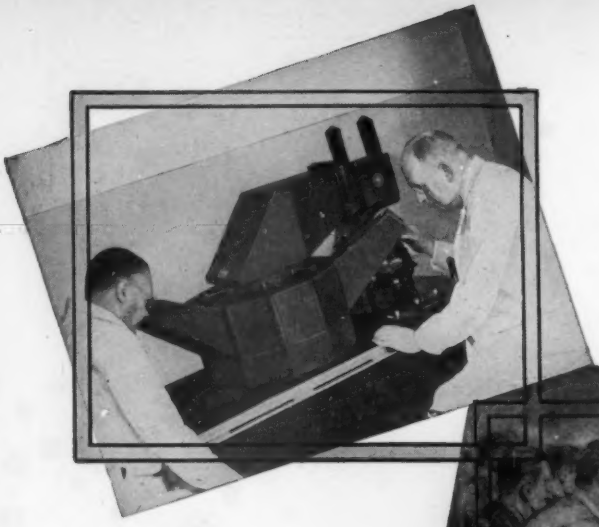
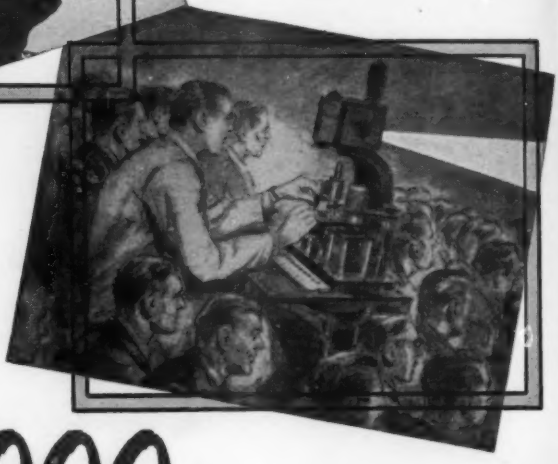


SMALL-GROUP STUDY IN A NORMALLY LIT ROOM

The image is cast upon a screen in the dark-chamber turret at table height. Each observer (up to 10) has a separate light-excluding viewing hood. The pathologist here is discussing a slide with the surgeon; the unused hoods are easily shuttered off.



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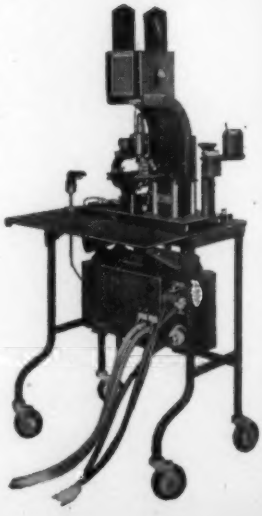

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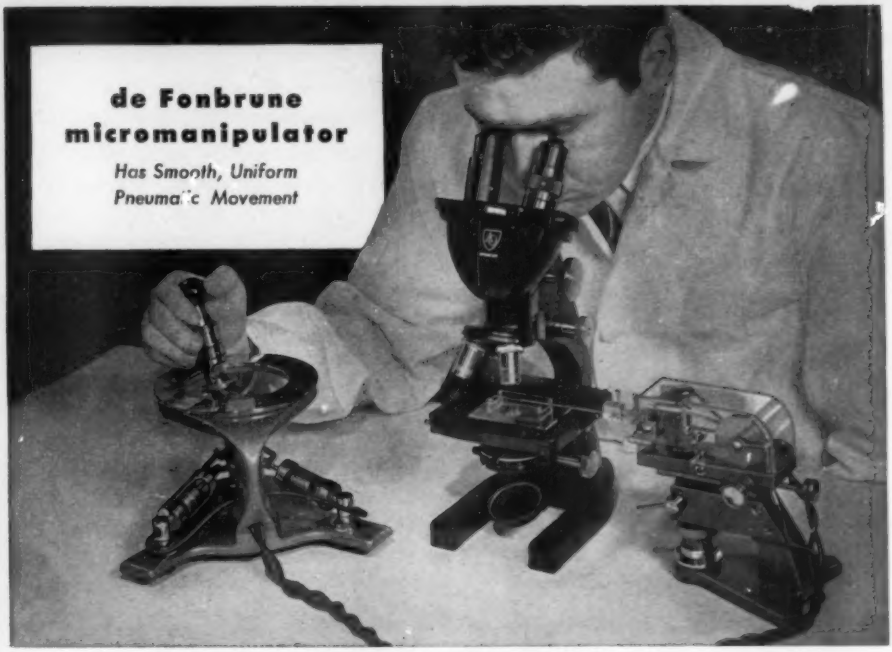

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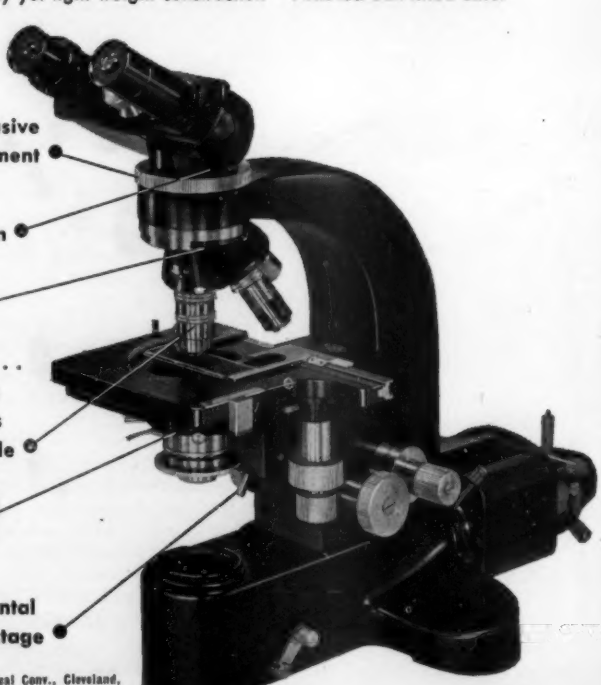

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The New Government Employee Security Program

On April 27, President Eisenhower issued an executive order establishing a new security program for Federal employees, scrapping the old loyalty check system and substituting the single criterion of security risk. Since the new program affects all scientists now in Government employment as well as all future applicants, and may, directly and indirectly, profoundly influence the progress of American science in the next few years, the Scientists' Committee on Loyalty and Security desires to bring the new program to the attention of American scientists and to explain the Committee's objectives.

The Scientists' Committee on Loyalty and Security,[1] a committee of the Federation of American Scientists, centered in the New Haven area, succeeds the Scientists' Committee on Loyalty Problems (SCIENCE, 111, 220 [1950]) and is concerned with security programs as they affect individual scientists, leaving to other groups the study of such programs with respect to civil liberties and democratic processes. A file of up-to-date information on loyalty and security regulations is maintained, and this information and informal advice is available to interested scientists upon request, but the Committee does not attempt under any circumstances to judge the merits of individual cases.

The Committee believes that national security can be maintained only by a proper balance of the need for security by secrecy, where it is necessary, against the need for long-range security by continuing scientific achievement. A major objective of the Committee is to make known the views of responsible American scientists, through the Federation of American Scientists and other interested organizations, and to cooperate with Government agencies and offer constructive advice on loyalty and security programs wherever feasible. The Committee attempts to remain alert to the broader problems of science and security, and may occasionally bring important facts and pressing problems to the attention of American scientists.

[1] E. C. Pollard, Chairman; R. S. Brown, Jr., E. C. Fowler, S. A. Goudsmit, H. G. Graetzer, M. A. Heald, G. A. Hedlund, F. Hutchinson, G. E. Hutchinson, W. J. Knox, J. K. Major, J. Phelps, J. M. Sturtevant, W. Rall, H. C. Wolfe.

The new Government employees security program represents an apparent major effort by the new administration to establish a workable program to clear up some of the confusion and shortcomings of the old system, and possibly arrest the trend toward ever increasing investigations by Congressional committees. Briefly, the new program abolishes the old Loyalty Review Board and replaces "loyalty" by "security" as a criterion of eligibility for Federal employment, leaves the agency head the final judge of eligibility, and extends the provisions of Public Law 733 (81st Congress, 2nd Session) to all departments and agencies of the Government.

The Scientists' Committee on Loyalty and Security believes that the efforts of the administration to bring the enforcement of security safeguards under the executive branch of the Government, and to replace unwieldy loyalty criteria with those of security, may be steps in the right direction. The Committee is conscious, however, of the great responsibility which the new program places on department heads and of the inequities and procedural differences which may arise unless the new program is administered with the greatest care. It remains to be seen how security standards will, in practice, be scaled to the actual requirements of an agency or of a particular project within an agency. The actual effect of the program on scientists in Government employment will not be clear until some procedural precedents have been established in the weeks and months just ahead. For this reason, the Committee feels further comments at this time would be premature, but intends to review the program after it has passed through its initial phases and has achieved some stability.

The Committee intends to continue its informal consultations with public officials, to offer constructive advice on how the program may best be administered in the interests of national security and how security standards may be scaled to the nature of the scientific work, and to call attention to injustices arising under the program. The Committee will welcome the views of responsible scientists on the new program, and is anxious to have cases of genuine injustice to scientists brought to its immediate attention. Correspondence should be addressed to the Scientists' Committee on Loyalty and Security, Box 2153 Yale Station, New Haven, Connecticut.

SCIENTISTS' COMMITTEE ON LOYALTY AND SECURITY
New Haven, Connecticut

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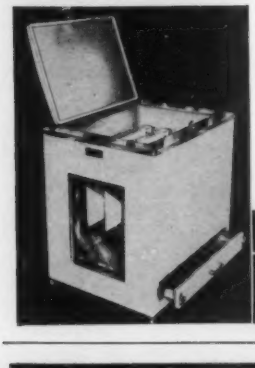

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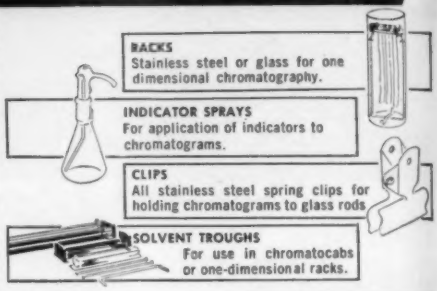

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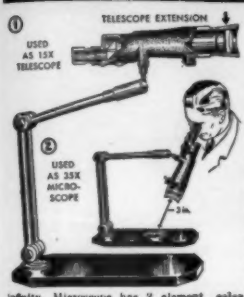

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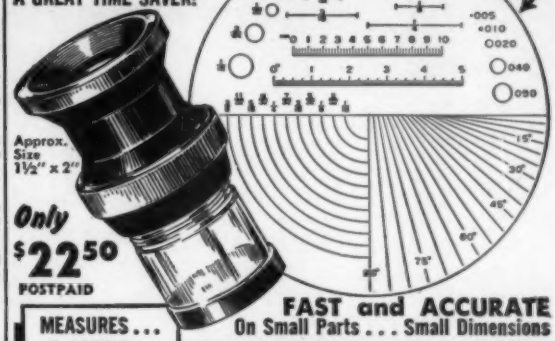

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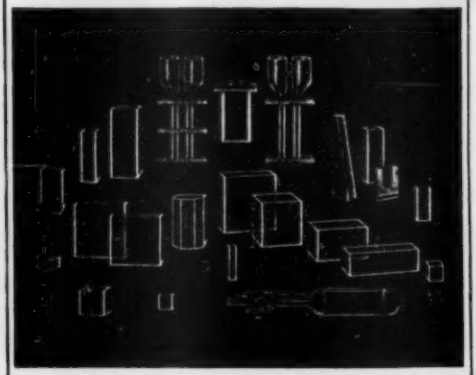

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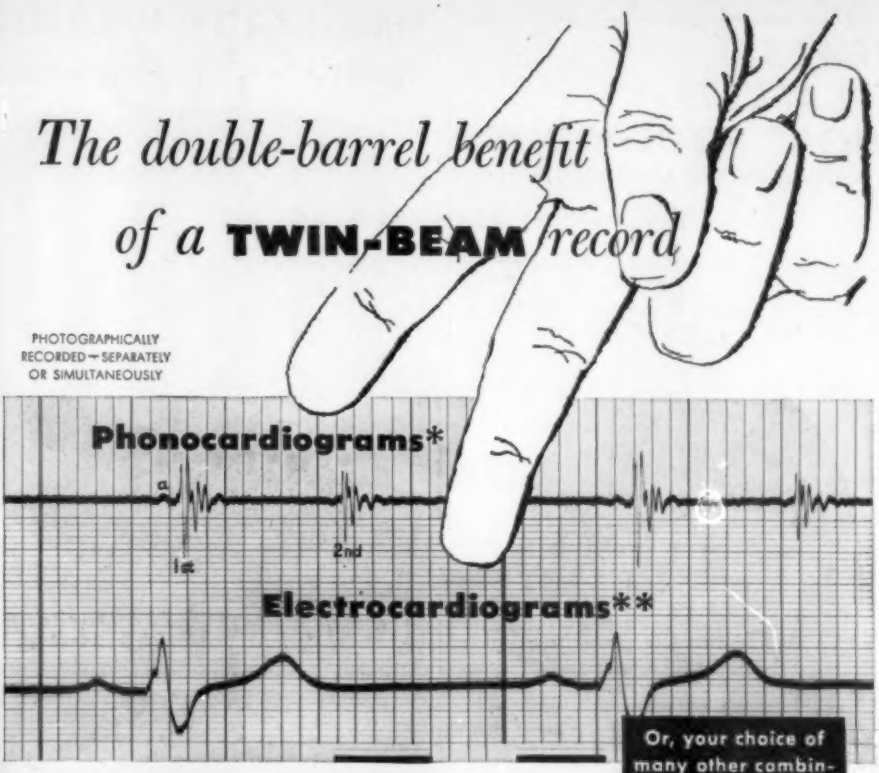

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National Manpower Council

EDITOR'S NOTE: On May 18 the statement on Scientific and Professional Manpower was published by the National Manpower Council. This survey and recommended policy are so significant for the consideration of all scientists and so thought-provoking that it seems highly desirable to print the following summary.

THE REPORT of the National Manpower Council[1] is the first comprehensive survey of problems and policies in the field of scientific and professional manpower.

It consists of (1) a policy statement by the Council itself that illuminates new and challenging issues of public policy affecting the development and utilization of highly trained manpower, and (2) twelve chapters of facts and issues prepared by the Council's research staff.

The policy statement contains five stated objectives and fourteen recommendations designed to help insure adequate resources of scientific and professional manpower for the nation.

Although better use of existing skills and the development of more potential capacities from undeveloped areas of wasted human ability are considered, the report makes it clear that there is no simple or magic formula for providing the United States with the highly trained brainpower it needs.

The report is a distillation of far more than the activities of the Council's seventeen members, and of its research staff, directed by Eli Ginzberg; indeed the Council has benefited immeasurably from the remarkable response of hundreds of scientists, professional men, and leaders in government, education, business, labor, and industry. The help of three major business groups, seventeen departments of the Federal Government, seven professional groups, and 117 individuals eminent in their own fields are specifically acknowledged in the foreword.

Even so, the Council considers the report exploratory rather than definitive. "Our objectives have been," writes Chairman James D. Zellerbach in the Preface, "to frame the problem, to identify its most important facets, to evaluate the existing evidence, to indicate the lines of policy where the evidence appears adequate, and to suggest where additional research and evaluation must be undertaken before a balanced judgment can be reached."

BACKGROUND

The National Manpower Council is a non-profit citizens' survey group established at the Columbia University Graduate School of Business with a Ford Foundation grant in April, 1951. The members were invited to serve by General Eisenhower to provide—in his own words at the time—"a continuing appraisal of America's manpower resources in a period of enduring emergency." The fulfillment of that objective involves identifying and evaluating areas of significant manpower wastage, determining methods of improving the utilization of human resources, and recommending ways of developing potential resources.

The Council's first report was issued in April, 1952, under the title *Student Deferment and National Manpower Policy*. The current study is its second. A third study, now in progress, is devoted to long-range problems involved in developing an adequate supply of technical and skilled workers.

Although General Eisenhower, as commander of SHAPE, was on leave from Columbia at the time, from Paris he took a hand in helping to organize the Council because of his active interest in the whole concept of a human resources research program at the University. He had already established there the Conservation of Human Resources Project and had encouraged the developing leadership of the University in this area. Thus, he quickly accepted the challenge for Columbia when the possibility of establishing a manpower council there was being explored by the Ford Foundation.

"My hopes are especially high," General Eisenhower said later in his farewell message to the alumni of Columbia, "for the help which will come to the new administration from our . . . National Manpower Council." He added that the research would continue to command his "active interest and encouragement," a pledge refulfilled by his reception of the Council members at the White House on May 18.

RECOMMENDATIONS

The National Manpower Council on the basis of this study believes that "there is no magic formula to insure that the United States will have adequate resources of scientific and professional manpower to meet its needs." It continues, "Nothing short of a determined cooperative effort involving government, industry, educational institutions and professional and other groups will attain this goal."

Such a cooperative effort, supported by informed public opinion, the Council adds, must achieve the following five broad and related objectives: (1) to develop more reliable knowledge about our human resources; (2) to strengthen the institutions which educate and train our scientists and professionals; (3) to maintain a continuous large flow of students through our colleges and universities; (4) to expand the oppor-

[1] *A Policy for Scientific and Professional Manpower*. Prepared by the Research Staff of the National Manpower Council. New York: Columbia University Press (1953).

tunities for capable young persons to secure a higher education; and (5) to improve the utilization of the available supply of scientific and professional personnel.

To achieve the first, the Council recommends: (1) that foundations and universities encourage and support research designed to increase our understanding of educational and career choice processes, of the factors facilitating the development of talent and intellectual ability, and of the conditions contributing to superior performance; (2) that private and governmental agencies concerned with the development and utilization of scientific and professional manpower intensify their efforts to collect and analyze significant information about these critical resources; and (3) that the Federal Government, because of its specific responsibilities and unique facilities, provide leadership for these cooperative tasks, under the guidance of the Office of Defense Mobilization.

To attain the second objective, the Council recommends: (1) that state and local governments, alumni, business, labor, and other interested groups and individuals intensify efforts to provide the financial support required for the improvement of faculties and facilities; (2) that the President appoint a commission composed of Government, university, and industrial representatives to review the impact of governmental research and development contracts upon the primary responsibilities of universities and colleges to advance fundamental knowledge and train tomorrow's scholars and scientists; and (3) that institutions of higher education recognize that a dynamic society requires the kind of education and training that equips students to meet not only the demands of their first jobs but also the challenges of new tasks and problems which they will face many years later.

For the third objective, to help maintain a continuous flow of students in colleges and universities, the recommendations are: (1) that the public continue to support the present student deferment program and that the President remove dependency, except in hardship cases, as a ground for deferment to insure that postponement of service does not become exemption;[2] (2) that the Secretary of Defense direct the Secretaries of the three armed services to provide sufficient flexibility in their policies governing the calling to active duty of students enrolled in ROTC programs so that well-qualified students are permitted to pursue graduate work prior to their military service.

The fourth objective, to help expand higher education opportunities for capable young people, requires: (1) that the public and elected officials fulfill their responsibility to maintain good elementary and secondary schools by providing the financial and personnel resources needed to remedy present weaknesses in the educational system; (2) that schools, professional societies, governmental agencies, and other interested groups act together to strengthen high school and college information and counseling services to insure sound selection of schools, courses, and careers; (3) that scholarship and fellowship programs supported by private and public funds be maintained and expanded to help more young people of ability to acquire a higher education.

For the last objective, to improve utilization of available scientific and professional personnel, the Council recommends: (1) that the President initiate a review of legislation and administrative procedures governing the recall of reservists to active duty in order to develop a system of providing civilian participation in determining the distribution of scientific and professional personnel required to meet civilian and military needs; (2) that management intensify its efforts to determine the most effective balance among the different types of manpower it employs in order to insure efficient and economical operations and to provide for the further training of the manpower for which it is responsible; and (3) that business and government intensify their efforts to develop executives who understand the importance of insuring that each highly trained employee has the opportunity to utilize his capacities as fully as possible.

Findings

In arriving at these fourteen major recommendations on the five objectives, the National Manpower Council developed basic findings in its policy statement, the highlights of which follow:

1) Scientists and professional people have been increasing twice as fast as the total population since 1900, but our 155,000 scientists today still constitute only two-tenths of 1 per cent of the total working population—and only 15,000 of these are devoting themselves to fundamental research essential to opening new frontiers of knowledge. Thus, the country's economic and social well-being and its continued progress depend to a striking degree on a small group of men and women in scientific and professional fields.

2) Numerically, according to some available studies, there is a shortage of 25,000 new engineers and 65,000 qualified elementary school teachers right now. Although there is no commonly accepted estimate of the current shortage of doctors, because there is no agreement on a standard of medical care or the number of doctors required to provide any given level of medical care, the President's Commission on the Health Needs of the Nation estimated that the counrty will be short from 22,500 to 45,000 physicians by 1960. There is little point in estimating the numerical shortage of physicists whose great importance to national security makes even a small shortage particularly critical.

3) In actual fact, there is little to be gained in trying to assess some shortages quantitatively. Quality is the key. Some shortages, of course, involve unfilled demands for hundreds or even thousands of qualified personnel, but many others consist of a lack of a few individuals who possess rare and unusual qualities.

4) Moreover, analysis of manpower shortages, their

[2] A similar recommendation is contained in the Council's report on Student Deferment published last year.

causes, significance and remedies, is hindered by grossly inadequate basic information concerning demand, supply, and utilization. A complete theoretical framework for analyzing manpower shortages still remains to be developed.

5) The emergency created by Communist aggression in Korea provides the key to many current shortages. Others have a longer history, going back a decade or more. Shortages of engineers and scientists are the result of demands produced by superimposing a program of partial mobilization on a civilian economy operating at a high level of employment. These shortages have delayed defense production, slowed progress on research and development projects vital to our security, and resulted in the production of some military items costly to operate and maintain. The recent enormous strides in nuclear physics and electronics have created higher demands for scientific personnel in industry. Also private industrial research, growing now for several decades, is bringing about greater practical application of scientific discoveries which increases the use of scientists by industry.

6) The teacher shortage goes back more than a decade. Attractive opportunities in private industry, the relatively low salaries and prestige of teachers, and the impact of World War II adversely affected the growth of supply of teachers. Few communities have been sufficiently far-sighted or resourceful to protect their supply of competent teachers. The spectacular growth of new industrial and suburban areas has also created unusual demands for more teachers.

7) In the medical field, an uneven distribution of doctors throughout the country has been a shortage factor while higher standards of health and a growing national income have increased the demand for medical service. At the same time, the capacity and admission requirements of the medical schools have limited the total number of doctors trained each year.

8) The future supply of scientists and professional people is directly dependent on college enrollments. The low birth rate of the 1930's and today's military manpower policies mean that not until the closing years of this decade will there be a substantial increase in the population of college age and in the number of college graduates. Meanwhile, all the signs point to a continuing strong demand for scientifically and professionally trained manpower. Even the termination of Korean hostilities would not end the cold war, and the consumption of educational, health, and other services provided by professional personnel is likely to increase even if genuine peace is established, because of the productivity gains and growing national income promised by continuing advances in science and technology.

9) Scientists and professional persons cannot be stockpiled like commodities against future shortages. Demands for them can fluctuate sharply and unpredictably. The supply can only change relatively slowly. The problem of preventing manpower shortages in a democratic society is complicated by major influencing factors which cannot be readily controlled, such as the dynamic character of modern science, economic trends, irregularities in the birth rate, and values affecting individual career decisions.

10) But the nation can follow two broad courses of action in attempting to prevent future shortages: (*a*) an effort to alter the distribution of young people among fields of scientific and professional study to increase the total of those preparing for work in anticipated shortages areas; and (*b*) an effort to expand the size of the whole college population so that more young men and women can be trained in each field.

11) The first possibility has the advantage, if energetically pursued, of producing results in a relatively short time with more students being induced to choose careers in fields such as engineering, physics, chemistry, industrial management, or teaching where shortages are now felt and long-term shortages are feared. But if the total college population remains stable, alterations in the distribution of students will mean growth of some fields at the expense of others. If able students are channeled into scientific and technological fields, the social sciences and the humanities will inevitably suffer. Thus, schools, professional societies, employers and others inducing young people to select particular fields of study assume serious responsibilities. Hasty and uninformed career decisions involve serious waste of individual abilities and community resources.

12) The second course of action would expand the source of supply from which the nation's scientists and professional persons come and would help to reduce the loss represented by the failure to train many able individuals. There are many more young men and women in the nation capable of profiting from higher education than are currently obtaining it. Today, only half of those capable of acquiring a college degree enter college. About two-fifths of those who start—many with superior ability—do not graduate. For every high school graduate who ultimately earns a doctoral degree there are twenty-five others who have the intellectual ability to do so but do not.

13) Three readily identifiable groups in the reserve of those capable of pursuing advanced education are: (1) high school graduates who do not enter college, (2) those who start college but do not graduate, and (3) those who graduate but do not pursue post-graduate training.

14) In addition, there is a hidden reserve that is composed of capable individuals who achieve low scores on tests of intellectual ability primarily because of serious deficiencies in their early schooling. They live for the most part in poor communities which spend little on education and are found particularly among such racial and ethnic minorities as Negroes and Spanish-speaking Americans. While barriers limiting their educational and occupational opportunities have been substantially reduced in recent years, many Negroes are still handicapped by poor education in

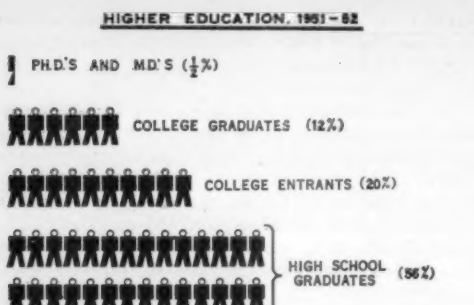
HIGHER EDUCATION, 1951 - 52
PH.D.'S AND M.D.'S (½%)
COLLEGE GRADUATES (12%)
COLLEGE ENTRANTS (20%)
HIGH SCHOOL GRADUATES (56%)
TOTAL COLLEGE-AGE POPULATION
= 2% OF THE POPULATION OF COLLEGE AGE

FIG. 1.

early life, and others are frequently prevented from using the skills they do acquire by discriminatory employment practices.

Growth of the Professions. Since 1870, professional and related workers have increased from half a million to about 5 million and from 3 per cent to 8 per cent of the labor force. Scientific and technical workers have increased more rapidly than any other professional group.

Since 1890, the proportion of young people completing high school has risen from 3½ per cent to almost 60 per cent. The proportion completing college has increased from 1 per cent to 12 per cent. Since the record class of 434,000 college graduates in 1950, the number of graduates has been declining, and will not begin to increase again until 1955 or 1956. The current decline is one basis of the concern over future shortages of scientific and professional manpower.

Since 1900, the number of master's degrees granted each year has risen from 1600 to 63,000. The number of Ph.D. degrees has increased from under 400 to about 7700. Over half of all Ph.D. degrees are now granted to students of the natural sciences.

Training and Occupational Distribution. The number of people who attend college depends largely on social attitudes toward the value of education. The number in each field of study is determined mainly by individual decisions based on preferences concerning the kind of work and life the individual wishes to have. Rapid changes in the supply of professional and scientific groups are difficult to achieve.

Because professional and scientific workers who are independent practitioners or employees of industry generally earn more than employees of non-profit institutions, schools and colleges, hospitals, and government agencies frequently encounter great difficulty in keeping or enlarging their staffs in periods of high employment and inflation. Under these circumstances, non-profit institutions are likely to lose first-rate personnel.

Discriminatory barriers against racial and ethnic groups and against women have been greatly reduced, but they still severely limit the number of Negroes and women in scientific and professional work. Few Negroes graduate from college, chiefly because their primary and secondary education often does not qualify them for or interest them in college.

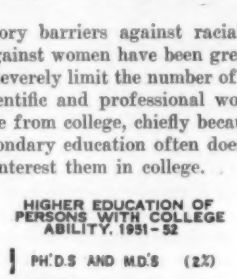
HIGHER EDUCATION OF PERSONS WITH COLLEGE ABILITY, 1951 - 52
PH.D.S AND M.D.'S (2%)
COLLEGE GRADUATES (37%)
COLLEGE ENTRANTS (49%)
(100%)
TOTAL WITH COLLEGE ABILITY
(1,400,000 PERSONS
18 THROUGH 21)

FIG. 2.

Potential for Higher Educaton. The nation has a vast reservoir of highly intelligent young people who are not pursuing their education beyond high school; only half of those with college ability enter college.

There is also a great reserve of highly able college graduates who do not undertake study for advanced scientific and professional degrees; only 4 per cent of college graduates earn a doctoral or an M.D. degree.

Finally, the utilization of these reserves for higher education is not a simple matter; many with high ability are able to secure remunerative employment which does not require advanced education.

Research and Development. In 1952, $3.5 billion, 1 per cent of the national income, was allocated for research and development. Only 160,000 of the nation's 700,000 scientists and engineers were engaged in research and development work, and only about 15,000 were engaged in basic research.

The Federal Government provided three-fifths of the total expenditures. The government does not spend more on research and development to improve the nation's defenses mainly because of the shortage of competent scientific and engineering personnel.

Too large a part of the governmental program is directed toward minor improvements in military equipment while the major need is for more radical approaches to the defense potential of modern science and technology.

Many members of scientific faculties in the universities are preoccupied with administering government projects, and many graduate students are working on narrow assignments on narrow projects. There is a

real danger that today's development work is being accomplished at a high cost in terms of the future quality and flexibility of the nation's scientific manpower and the advancement of basic knowledge.

Armed Forces and Highly Trained Manpower. In building its strength to 3.6 million after the outbreak of hostilities in Korea, the armed forces took from the civilian labor force a small but important number of highly trained individuals, including scientists and professionals.

Since the armed forces had no well-developed personnel classification and assignment procedures by which individuals with scarce skills could be immediately identified and placed in the work best suited to meeting military requirements and to using the special abilities of individuals, a certain amount of malutilization resulted. In recent months, however, all the military services have developed specific policies and procedures which, if carried out, will assure the proper assignment of these key individuals.

Most of the men entering military service for the first time are young men with little training and experience. In order to obtain the substantial numbers of scientists, professional and semiprofessional personnel, and especially of trained technicians which a modern military establishment needs, all the services operate training programs which are enormous in scope. Of the men entering service, some 35 to 65 per cent (depending on which service they enter) must receive special training. Since few men remain in military service after their first period of service, the civilian economy receives much of the benefit of this training.

Nature of Manpower Shortages. A manpower shortage cannot be evaluated without consideration of alternative ways of raising production of one type of goods or services and of society's needs for other types of goods or services which are produced with the same scarce resources.

Manpower shortages are different from commodity shortages since the supply of trained people cannot be increased rapidly, stockpiled, rationed, or shipped to wherever it is needed, and because of vast differences in the competence of individuals.

The only quick remedy for manpower shortages lies in improvements in utilization that stretch the available supply. During the present period of partial mobilization, however, the nation is not disposed to accept compulsory manpower or production controls. Currently, cost-plus contracts, federal tax policies, and inflation encourage inefficient utilization of manpower.

Persistent shortages of scientific and professional manpower cannot generally be relieved without efforts to increase the supply by expanding educational facilities and increasing the numbers who are financially and intellectually capable of completing training and have the desire to do so.

Increasing the supply will not automatically solve shortages in many fields. Shortages of teachers, of nurses, and of doctors for salaried positions, for instance, will not be remedied unless employment in these fields is made much more attractive.

The Engineering Profession. Since Korea there has been a widespread shortage of engineers caused by increased defense expenditures, coupled with a reduced supply of new graduates. The shortage has been intensified by efforts of employers to stockpile engineers against future shortages.

The demand for engineers is subject to wide variations with changing business conditions. Although defense expenditures will probably level off in the near future, continued high levels of private investment mean that, barring a severe recession, the total demand for engineers will continue strong.

The demand for engineers is a demand for men to perform a wide variety of functions from top management down to routine testing. Thus, shortages of both sub-professional technicians and of competent administrators have increased the demand for engineers. Although it is estimated that industry can use from 3 to 5 technicians for each engineer it employs, the number of engineers who graduate from college each year is far greater than the number of technicians who graduate from recognized technical schools.

Although industry needs executives with a technical background, executive employment may not make full use of the engineer's training. If liberal arts and business colleges were to include some measure of technical training in their curricula, industry could have a large additional source of supply to draw upon to fill management and sales positions.

Physicists. There are fewer than 20,000 physicists in the United States, and only 4000 who have doctoral degrees. Although the number with doctoral degrees has increased steadily since 1900, the expansion is limited by the very high intelligence required, by the fact that relatively few people are attracted to scientific research careers, and by the fact that many high schools do not provide their students with adequate training in mathematics or with an introduction to the qualities of natural science.

There is now a shortage of physicists with all levels of training to assist in translating new scientific developments into the field of engineering. This shortage can best be relieved by providing additional mathematical and scientific training for engineers.

There is also a shortage of mature physicists to supervise applied research projects for industry and the government. There is no substitute for the experience which comes with time in relieving this shortage.

There is always a shortage of first-rate minds capable of making major scientific advances. The security of the nation depends as never before upon creating the conditions which will encourage fruitful basic scientific research.

Teachers. Every community can get as many teachers as it wants by sacrificing its standards of quality. In 1952, there were approximately 64,000 "emer-

gency" teachers, that is, persons with inadequate academic preparation according to existing standards.

Although part of the shortage of qualified teachers is caused by the rise in the birth rate during the early 1940's, the unattractiveness of the profession itself is a basic cause. Low salaries deter bright students, especially men, from entering the profession. The resulting predominance of women, many of whom teach for only a few years, further aggravates the shortage. The limited curricula and relatively poor mental ability of students in many teachers' colleges further deter bright students from entering training.

In attempts to relieve the present shortage strong emphasis has been placed on stop-gap measures such as emergency certificates, and advertising appeals to former teachers to return to the schools. These measures do no more than touch the surface of the problem.

Many states have tried to remedy the shortage through basic measures such as increasing state aid to local school systems to give greater flexibility to school budgets and by seeking to improve the quality of teacher training.

To be successful, such basic measures must be part of a coordinated program. Although few other measures will be effective without an improvement in the salary structure, neither can salary increases alone be relied upon to raise both the quantity and quality of the nation's teachers.

Physicians. Although there is widespread agreement that there are shortages of particular kinds of doctors for specific functions, there is no agreement on how many doctors the country now needs. It has been estimated by The President's Commission on the Health Needs of the Nation that the country will require from 22,500 to 45,000 more physicians than it will have in 1960.

A more rapid increase in the number of medical school graduates would help to reduce many health deficiencies in the population and to relieve the exceedingly long hours and hard work of many doctors.

Increasing the number of doctors trained requires an increase in the capacity of the medical schools. A substantial increase in their capacity is made difficult by the high cost of medical training, the shortage of teachers and of clinical material, and the necessity of maintaining the quality of training.

Increasing the number of doctors will not in itself solve some of the most serious shortages such as those in rural areas, for salaried positions, and for the practice of various specialties.

Improved medical care can also be brought about by improving the utilization of the existing supply of doctors through the employment of additional auxiliary personnel and other measures.

Manpower Policies in a Democratic Society. Because of the international situation, the Federal Government now has a heavy responsibility to develop within its authority new approaches to long-range manpower policies.

The basic information for the solution of many manpower problems is not available. A theoretical framework for the analysis of manpower shortages, and better knowledge of the factors which influence the supply of scientific and professional personnel are especially needed.

A democratic society must rely on voluntary and primarily indirect methods for attaining its manpower goals. The creation of conditions which will make for a reasonable balance between the supply of and demand for highly trained manpower can only be the product of a vast cooperative undertaking.

An important part of the solution must be the development of a more sympathetic climate for intellectual endeavors which will make them attractive to able young people.

News and Notes

First Palynology Conference

THE First Palynology Conference was held at Yale University on February 21, 1953. The purpose was discussion of current investigations being carried out principally on the North American continent by workers in the field of microfossil research. Although originally outlined as a local meeting between the group at the University of Massachusetts, headed by L. R. Wilson, and that at Yale, the plan was enlarged to include the majority of workers in the United States. Seventeen papers were presented and informally discussed during two sessions. Those concerning research being undertaken on Pleistocene material were presented during the morning session, but in the afternoon, the papers were for the most part concerned with pre-Pleistocene studies. Paul B. Sears presided at the morning gathering, and Edward S. Deevey, Jr., presided during the afternoon.

Participants, their affiliation, and titles were as follows in the order of their presentation:

Stanley A. Cain, University of Michigan: "The Use of Size-Frequency in the Determination of Species of Pollen"; John F. Grayson, University of Michigan: "A Size-Frequency Study of Fossil *Pinus* Pollen from Lake Bottom Sediments of the George Reserve, South-

eastern Michigan''; Eilif Dahl, University of Oslo, Norway: ''Climatological Interpretation of Postglacial Pollen and Microfossil Records''; David G. Frey, Indiana University: ''Wisconsin and Post-Wisconsin Palynology of Eastern North Carolina''; Patrick Butler, Harvard: ''Pollen Studies of Smalls Swamp, Cape Cod, and of the Barnstable Marsh, Cape Cod''; Alan C. Donaldson, University of Massachusetts: ''A Microfossil Analysis of a Cape Cod Peat Bog''; Heikki Ignatius, Yale: ''Late-Glacial and Postglacial History in North-Central Quebec—Ontario, Canada''; L. R. Wilson, University of Massachusetts: ''Peat Pollen Studies in the Region of Eastern Ontario, Canada''; Estella Leopold, Yale: ''Current Pollen Studies in Certain River Terraces of Northeast Wyoming''; William S. Benninghoff, U. S. Geological Survey: ''Some Applications of Palynology to the Earth Sciences in Alaska''; Daniel Livingstone, Yale: ''Some Pollen Diagrams from Northern Alaska''; Calvin J. Heusser, Yale: ''Additional Pollen Profiles from Southeastern Alaska''; Margaret K. Wolfe and E. S. Barghoorn, Harvard: ''Fossil Maize from the Valley of Mexico''; K. H. Clisby, F. Foreman, and L. Zeevaert, Oberlin College and Mexico City: ''Fossil Pollen and Stratigraphy from Two Deep Cores under the City of Mexico''; Richard P. Hamilton, University of Massachusetts: ''Plant Microfossils in the Lower Wilcox of Arkansas''; Arthur E. Le Blanc, University of Massachusetts: ''Microfossil Studies of Sediments from Rockport, Texas''; Elso S. Barghoorn, Harvard: ''Pollen and Spores of the Brandon Lignite and their Paleoecological Significance.''

The meeting included a conducted tour of the Geochronometric Laboratory by Dr. Deevey and a buffet supper at the home of Dr. and Mrs. Sears. An opportunity was also afforded for the examination of microscope slides to members of the conference. Enthusiastic response to this meeting stimulated an invitation from Stanley A. Cain for a Second Palynology Conference to be held at the University of Michigan next year. Abstracts of papers presented at this first meeting are planned to be included in the forthcoming issue of the *Pollen and Spore Circular.*

CALVIN J. HEUSSER

Osborn Botanical Laboratory
Yale University

Scientists in the News

Hugo Benioff, Professor of Seismology, California Institute of Technology, has been appointed to a one-year term on an advisory panel of the National Science Foundation. He will represent the pure science of geophysics. Dr. Benioff has also been elected vice president of the Section of Seismology, American Geophysical Union.

Robert Bierstedt has been appointed Professor of Sociology and Chairman of the Department of Sociology and Anthropology at the College of the City of New York. Dr. Bierstedt, now Associate Professor of Sociology at the University of Illinois, will take office Sept. 1.

Lyman J. Briggs, former director of the National Bureau of Standards, has received from the Scientific Apparatus Makers Association an award for outstanding achievement in fulfilling his responsibilities to the scientific and technical professions of America.

C. O. Claggett, Professor of Biochemistry and agricultural chemist in the North Dakota Experimental Station, is the new president of the North Dakota Academy of Science.

A. Erdélyi, Professor of Mathematics at the California Institute of Technology, has been elected a Foreign Member of the Academy of Sciences of Turin, Italy. Dr. Erdélyi is also a Fellow of the Royal Society of Edinburgh.

Clarence N. Ferguson has joined Bjorksten Research Laboratories, Inc., Madison, Wis., as research chemist. He will do exploratory research on glass-filled plastic film.

Willis A. Gortner, head of the Chemistry Department of the Pineapple Research Institute, Honolulu, plans to spend three months of his sabbatical leave in the laboratories of the Bjorksten Research Foundation. He will work on problems related to the fundamental chemistry of aging, in conjunction with a program carried on at the Foundation.

Palmer H. Graham, Associate Dean of the New York University Washington Square College of Arts and Sciences, will retire at the close of this semester. Dr. Graham was also professor of mathematics, head of that department, and acting dean during his 33-year career at NYU.

William H. Hall, Dean of the Duke University College of Engineering, has resigned. Dr. Hall has been a member of the faculty for 38 years and dean of the college since it was established in 1939. He will remain at Duke as J. A. Jones Professor of Engineering. **Walter J. Seeley** will succeed Dr. Hall as dean, effective July 1.

James G. Halpin, Chairman of the University of Wisconsin Poultry Husbandry Department since 1909, will retire in June. He intends to continue his research in poultry feeding, and is currently concerned with teaching chickens to eat hay.

Charles Huggins, Chicago surgeon and research investigator, received the 1953 Research Award of the American Pharmaceutical Manufacturers' Association.

Wingate M. Johnson, Professor of Clinical Internal Medicine, will become associate dean of the Bowman Gray School of Medicine. Dr. Johnson will be acting head of the medical school in July, when **Coy C. Carpenter** begins a leave of absence to serve as Fulbright visiting professor in Egypt (SCIENCE, 117, 494).

Wilbur E. Kellum, U. S. Navy, has received the Theodore C. Lyster Award of the Aero Medical Association, for achievement in the general field of avia-

tion medicine. Other Association awards went to **Walter F. Grether** and to **James P. Henry,** for accomplishment in the psychological and psychiatric aspects of aviation medicine.

Karl Maramorosch, plant pathologist at the Rockefeller Institute for Medical Research, will spend part of the summer at the Virus Research Laboratory in Wageningen, Holland, at the invitation of the Wageningen Agricultural University. Dr. Maramorosch has also been selected by the organizing committee of the VI International Congress of Microbiology in Rome as a speaker in the Plant Virus Section. He will report on the multiplication of plant viruses in insects.

Herman Mark of the Polytechnic Institute of Brooklyn, has been made an honorary doctor of Uppsala University. Dr. Mark will lead a discussion on macromolecules at a symposium in Uppsala in connection with the 13th International Chemistry Congress in Stockholm, July 29–August 4.

John R. McGibony, Medical Director and Chief of the Division of Medical and Hospital Resources, U. S. Public Health Service, has been named Professor of Hospital and Medical Administration in the University of Pittsburgh School of Public Health. He will succeed **Glidden L. Brooks,** who has resigned as of July 1, to become Medical Director of United Cerebral Palsy.

Henry E. Meleney, Hermann M. Biggs Professor of Preventive Medicine at the College of Medicine of the New York University-Bellevue Medical Center, has resigned, effective June 30. He has accepted appointment to the faculty of the School of Medicine of Louisiana State University, New Orleans.

James H. Potter has been appointed Professor of Mechanical Engineering, Associate Dean, and head of the Mechanical Engineering Department at Stevens Institute of Technology. Dr. Potter has been on leave from the University of Illinois, participating in the "educator program" of the Du Pont Company. He will succeed **Richard F. Deimel,** now Professor Emeritus, at Stevens.

Emil H. Praeger has been selected by the Metropolitan Section of the American Society of Civil Engineers as Metropolitan Engineer of the Year. Mr. Praeger won the citation for his concept and design of Pier 57, Hudson River.

Milton Rosenbaum, Professor of Psychiatry at Cincinnati University's College of Medicine, will assist in the establishment of a new department of psychiatry at the Hebrew University-Hadassah Medical School in Jerusalem. Dr. Rosenbaum left New York for the Holy Land on May 26.

Willard O. Thompson, editor of the *Journal of the American Geriatrics Society,* has been named by the Mississippi Valley Medical Society as its Distinguished Service Award recipient for 1952.

Education

The Griffis Medical College Library Fund has been established, income from which will be expended for books for the **Cornell University Medical College** in New York City. The fund was endowed by Stanton Griffis, Cornell alumnus and trustee emeritus.

A program leading to the Ph.D. in Agronomy at the **University of Florida,** Gainesville, has recently been authorized. Areas of specialization will be crop production or genetics and plant breeding. The program will begin in September.

Fifty-two college and secondary school students with potential ability for leadership in scientific research have been chosen to participate in this summer's research training program at the **Roscoe B. Jackson Memorial Laboratory** at Bar Harbor, Me. The students, representing both private and public institutions from 25 states, will have direct experience in research problems with workers at the laboratory, which is devoted principally to the study of the heredity of cancer and allied diseases.

Grants and Fellowships

The following **AAAS Research Grants** have been awarded: Illinois State Academy of Science, to Troy C. Dorris, Quincy College, to Dorothea Franzen, Illinois Wesleyan University, to Sister M. Joan, College of St. Francis, Joliet, and to W. M. Gersbacher, Southern Illinois University; Louisiana Academy of Science, to John B. Entriken, Centenary College, Shreveport, to George H. Bick, Tulane University, and to John A. Moore, Louisiana Polytechnic Institute, Ruston; Ohio Academy of Science, to Louis Mills Thomson, University of Toledo, to D. C. Crowell, College of Wooster, and to Cecil Riser, Junior Academy Division, O.A.S.; Tennessee Academy of Science, to John M. Carpenter and to J. Gordon Ogden III, University of Tennessee.

Harlem Hospital, New York City, and six universities throughout the country have been recipients of **Damon Runyon Memorial Fund** grants for cancer research, totaling $113,600. Other recipients include Howard University College of Medicine, Stanford University School of Medicine, University of Louisville, University of Kansas Medical Center, University of Chicago, and University of Florida.

Six new undergraduate scholarships supported by industry have been set up at **Lehigh University.** The value of the six new grants will be $5400, and the donors include National Aniline Division of Allied Chemical and Dye Corporation, New York, and Clevite Corporation, Cleveland.

The National Research Council has announced the availability of the **Merck Senior Postdoctoral Fellowships in the Natural Sciences** for 1953–54. Citizens of the U.S. with a Ph.D. or equivalent in physics, biol-

ogy, or chemistry, and with at least three years' post-doctoral experience in their major field, of which only one year may have been fellowship work, are eligible. The Fellowships carry stipends of $6000 and traveling expenses.

At a conference sponsored jointly by the **National Research Council** and the **National Science Foundation,** meeting May 20, representatives of 21 industrial companies discussed the role of privately supported industrial fellowship programs in meeting the needs of the nation for trained scientific manpower. The conference provided opportunity for exchange of views among industrial representatives on the responsibilities of business and industry for support of advanced scientific training through fellowships and the means by which fellowship programs have been privately established. It was apparent that a need exists for cooperation among public and private institutions sponsoring industrial fellowships if future needs for scientific manpower are to be met. Similar conferences in the future may serve to bring this about.

Wayne University has received $45,338 in gifts and grants. Three grants from the U. S. Public Health Service were received for research in problems related to blood coagulation and to the use of estrogen determination for investigation of hormonal functions. Carl Djerassi of the chemistry department will explore natural products from cacti and will direct a fellowship in organic chemistry made possible by a grant from the Squibb Institute.

In the Laboratories

The **Blood Grouping Laboratory** of Boston, under the direction of Louis K. Diamond, has resumed the production of blood typing anti-sera on a commercial scale. A new building which will house the research and production activities of the laboratory is now under construction, and will be ready for occupancy early this summer. The new building will permit greatly increased production of anti-sera for the identification of all the common antigens and most of the rarer ones. Research will center around the causation, treatment, and prevention of erythroblastosis fetalis, transfusion reactions, identification of blood group antigens, and antibodies, as well as studies in the basic problems of human immunology.

New additions to the staff of the **Los Alamos Scientific Laboratory** include: Edward Baron, Bernard Hayes, George L. Ragan, Ruth M. Scully, Evan E. Campbell, Paul D. Edwards, and Wilhelm T. Kowalewski.

A new underground atomic laboratory has been completed at **Yale University.** The 20′×40′ inner chamber will house a 20-million volt linear accelerator which is scheduled to begin operation late this summer. The machine is to inaugurate a new research program in the field of nuclear physics.

Meetings and Elections

A meeting of the **American Physical Society** will be held at the University of Rochester June 18–20, on the River Campus of the College for Men. The Society's Division of Electron Physics will meet at the University on the same dates. About 15 invited and 80 contributed papers will be presented by physicists from both the U. S. and Canada.

A conference of nuclear physicists at **Indiana University** discussed the riddle of the structure of the atomic nucleus. Allan C. G. Mitchell of the Indiana University Physics Department, arranged the conference. In attendance were Maria Goeppert Mayer, University of Chicago; E. J. Konopinski, Indiana University; L. W. Nordheim, Duke University; M. E. Rose, Oak Ridge Laboratory; E. Feenberg, Washington University; and K. Ford, Princeton University.

The American Chemical Society's 13th **National Organic Chemistry Symposium** will be held June 15–18 at the University of Michigan, Ann Arbor. New approaches to the synthesis of penicillin, advances in the study of growth factors, and recent research on the action of the body's enzymes will be described. Hermann O. L. Fischer, lecturer in biochemistry, University of California, will address the symposium dinner.

A symposium on the biology and control of oyster predators, principally the carnivorous snails, will be a feature of the annual meeting of the **National Shellfisheries Association.** The meeting will be held at the Oyster Institute of North America, New Orleans, June 22–25.

The **New Orleans Academy of Sciences** has elected the following new officers: president, Karlem Riess, Tulane University; vice president, Joseph A. Ewan, Tulane; secretary, John H. Mullahy, Loyola University; treasurer, Philip C. Wakeley, U. S. Forest Service. Elected to the executive committee were Jack Sands, Southern Regional Laboratory, and Paul Bailey, Loyola. Garland Taylor of Tulane University was appointed curator.

Officers of the **North Carolina Academy of Science** for 1953–54 are: president, D. B. Anderson, North Carolina State College; vice president, Florence L. Schaeffer, Woman's College of the University of North Carolina; secretary-treasurer, John A. Yarbrough, Meredith College.

New officers of the **Society for Research in Child Development** include H. V. Meredith, University of Iowa, president, and Celia B. Stendler, University of Illinois, secretary. Members of the Governing Council will be Roger Barker, Nancy Bayley, Icie M. Hoobler, Boyd McCandless, Esther McGinnis, and Carroll E. Palmer.

A Summer Conference on College Biology, sponsored by the National Science Foundation, will be held at the University of Oklahoma, June 15–19. The topic

will be "Integration of recent research findings into the introductory training of scientific personnel." Harriet Harvey, Department of Zoological Sciences, University of Oklahoma, is director of the Conference.

The **Wenner-Gren Seminar in Physical Anthropology** will be held at the Forsyth Dental Infirmary for Children, Boston, June 22–25. The overall problem will be "The role of physical anthropology in medical and dental research." All interested persons may attend, and information is available from the director, W. M. Krogman, Graduate School of Medicine, University of Pennsylvania.

Miscellaneous

Paul S. Martin, Chief Curator of Anthropology of the **Chicago Natural History Museum,** has left to open the nineteenth in a series of archaeological expeditions to the Southwest. John B. Rinaldo, museum archaeologist, will shortly join Dr. Martin, as will other archaeologists and a corps of workers to help on the "dig." Further investigations on the prehistoric Mogollon Indians will be carried out in Pine Lawn Valley near Reserve, New Mexico.

Recent foreign visitors at U. S. government departments included: at the **Department of Agriculture,** Joachim von Schweinichin, Milan, Italy; at the **National Bureau of Standards:** Lawrence Wettern, West Drayton, England; Norman E. G. Hill, Royal Aircraft, England; C. A. Jarman, London; David Kendall, Oxford University; Jean Ginoux and Jacques Planquart, Brussels; Miguel A. Catalan, Madrid; Guro Gjellestad, Olso; Oscar Peters, Louvain, Belgium; N. M. Mowart, England; Mikishi Abe, Japan; Ernst Halpern, Vienna; Eugen Dorrer, Paris; C. W. Bunn, England; N. Minorsky, University of Aix-Marseilles, France; Paul Erdös, Budapest; Taichiro Shiraiwa, Hajime Suzuki and Atsushi Nakamura, Tokyo; and Toyohiko Okabe and Yoshitaka Iwasa, Kawasaki City, Japan.

Duke University will launch a new Medical Town-Hall for the people of Durham and the state of North Carolina. The first program, a panel on polio, will be held in Duke's Page Auditorium June 7 at 4 P.M. Speakers will include Duke faculty members, as well as guests who are authorities in their fields. Portable microphones will be set up for the convenience of the public, and about a half hour of the time will be used for questions. Admission to the programs will be free.

A group of eight engineers, six from Thailand and two from Turkey, has been given training at **Geological Survey** headquarters in Washington, D. C., in a version of the course given periodically to new members of the Survey's Water Resources Division. At the end of a week's training, the group began a tour, receiving additional instruction in Utah, Oregon, Washington, and Colorado on irrigation practices. The trainees hope to aid in the systematic development of their nations' ground water resources. The Thailand group includes Duang Bunnag, Thongchai Chotibut, Phrasarn Leelasara, Paisarn Sukumparnich, Adul Thavisri, and Vichin Tiraparnish, all engineers in the Royal Irrigation Department. Turkish representatives are Sebahattin Sayin and Osman Bedi Usta of the Hydraulic Department, Ministry of Public Works, in Ankara.

Members of the **National Research Council,** industry, and the military met at the Quartermaster Food and Container Institute for the Armed Forces in Chicago on April 28–29. Purpose of the session was a study of current research and development contracts sponsored by the Institute, and possible additional contracts. The NRC Committee on Packaging is responsible for advising on the adequacy of outside contracts for research and development work.

New journals received: *ABT.* Abstracts of Bioanalytic Technology. Editor, H. E. McDaniels, Council of American Bioanalysts, The John Crerar Library, 7 West Madison St., Chicago. $5.00 per year. Quarterly . . . *Acta Pathologica Japonica* Vol. 1, No. 1, Jan. 1951. The Japanese Pathological Society The Pathological Institute of the Tokyo University, Hongo, Tokyo. $3.00 per year. Quarterly . . . *Australian Journal of Chemistry,* Vol. 6, No. 1, Feb. 1953, and *Australian Journal of Physics,* Vol. 6, No. 1, March 1953, were formerly published as *The Australian Journal of Scientific Research, Series A: Physical Sciences.* The volume numbering of these new periodicals continues that of the earlier journals. Editor, N.S. Noble. 30s per year for each of the two journals. Both are quarterly . . . *Australian Journal of Zoology.* Vol. 1, No. 1, Jan. 1953. Editor, N.S. Noble. C.S.I.R.O., Melbourne, Australia. Issued as material becomes available. 7s 6d per issue . . . *Bulletin.* American Anthropological Association. Vol. 1, No. 1, April 1953. Formerly, *News Bulletin.* Published by the Association. Executive secretary, F. Johnson, Andover, Mass. Free to members, Quarterly . . . *Everyday Science.* Vol. 1, No. 2, Jan. 1953. Editor, B. D. Kochhar. Northern India Science Association, Hargold Road, Ambala. Cantt., India. 10s per year, foreign. Quarterly . . . *Publicaciones de la Comision Nacional de la Energia Atomica.* Serie Matematica, Vol. 1, No. 1. Buenos Aires.

The **University of Michigan** will give its entire crustacean collection to the U. S. National Museum. The collection has particularly good specimens from the regions of the Great Lakes and the Ozark Plateau. It is felt that more use can be made of these specimens by researchers at the Museum, which has long been a major center for work on the Crustacea.

CORRECTION. In the obituary on F. R. Moulton published in the May 22 issue of SCIENCE, the date of Dr. Moulton's retirement from the AAAS was wrongly given. Although Dr. Moulton served the Association as Permanent Secretary until 1946, he continued to fill this position under the new title of Administrative Secretary until January 1949.

Technical Papers

The Mass Isolation of Whole Cells from Rat Liver[1]

Norman G. Anderson

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In a study of the effects of various perfusion media on cell breakage during homogenization, it was noted that the use of mixtures of equal parts of isotonic sodium citrate and calcium-free Locke's solution resulted in a suspension consisting mostly of whole cells (*1*). The effects of the inclusion of several divalent-ion binding substances in perfusion media on the percentage of whole cells in homogenates prepared under standard conditions will be considered here, and a method for preparing whole cells in about 40–50% yield will be presented.

Previously, liver whole cells have been prepared in low yield (5–10%) by forcing liver through cheesecloth (*2*), by shaking slices with glass beads (*3, 4*), by mincing with a tissue press (*5*), or by homogenization with a Potter-Elvehjem grinder (*6*). Purification has usually been achieved by centrifugation. The use of liver whole cell preparations, as pointed out by Potter (*7*), appears to offer promise (*4, 7, 8*).

The intercellular cement is generally considered to consist, for the most part, of a slightly soluble calcium salt. Removal of the calcium by the use of calcium-binding substances, such as citrate or oxalate, results in a softening of this cement (*9–12*). In the experiments reported here pyrophosphate, ethylenediamine tetraacetate (Versene), glycerophosphate, and adenosinetriphosphate (ATP) have been studied in addition to citrate. Versene is well known as a chelating agent, and ATP has been shown by Neuberg and coworkers (*13*) to complex a number of divalent cations.

Adult rats of the Sprague-Dawley strain were stunned, decapitated, and perfused through the dorsal aorta until the livers were well blanched with the solution under investigation. In the majority of the experiments back perfusion via the hepatic vein was also employed. Perfusion was generally completed within 3–4 min after the rat was stunned. The livers were excised and weighed in a tared beaker of cold calcium-free Locke's solution. Sufficient solution was removed to give a ratio of 1 g of liver to 10 ml of final suspension. The liver and solution were then transferred to a Pyrex homogenizer tube, and the liver broken up by pressing down with a loose-fitting lucite pestle. This was followed by twenty even up-and-down strokes by hand. Shreds of connective tissue containing many cells remained after this treatment, but they were readily removed by straining through 10XX bolting silk. Experience has shown that further homogenization to release more whole cells increased the contamination with fibrous debris and broken cells and did not give a much greater yield, owing, evidently, to breakage of cells previously released. Cutting the liver up into small cubes or slices with a razor did not appear to improve the yield.

Perfusion solutions were made by mixing approximately isotonic solutions of the sodium salt of the complexing agent with calcium-free Locke's solution in ratios ranging from 1 : 3 to 1 : 19. The final solutions were adjusted to pH 7.0 with HCl or NaOH as necessary.

The relative numbers of nuclei and whole cells were counted in small aliquots, dark-medium phase contrast being used. A total of approximately 1000 whole cells and nuclei were counted in each preparation. Since approximately 31% of the liver cells of the adult rat are binucleate (*3*), the number of cells broken may be calculated by dividing the number of nuclei by 1.31. This value, added to the number of whole cells counted, gives the number of cells contributing to the samples counted. The percentage of whole cells was calculated by dividing the number of whole cells counted by the

TABLE 1

EFFECT OF INCLUSION OF VARIOUS SUBSTANCES IN PERFUSION MEDIUM ON PERCENTAGE OF WHOLE CELLS IN HOMOGENATES

Substance	Molarity	% whole cells
Citrate	0.027	38*
	0.027	31*
	0.027	69
	0.027	47
	0.0138	49
	0.0138	56
Pyrophosphate	0.030	60
	0.030	73
	0.015	56
	0.006	12
	0.006	14
Versene	0.0276	60
	0.0138	67
	0.0138	49
	0.0055	57
	0.0055	55
Adenosinetriphosphate	0.0138	64
	0.0055	52
	0.0055	31
Glycerophosphate	0.035	16
	0.0175	17
Complete Locke's	—	6
	—	12
Ca-free Locke's	—	14
	—	12

* Back perfusion omitted.

[1] Work performed under Contract No. W-7405-eng-26 for the Atomic Energy Commission.

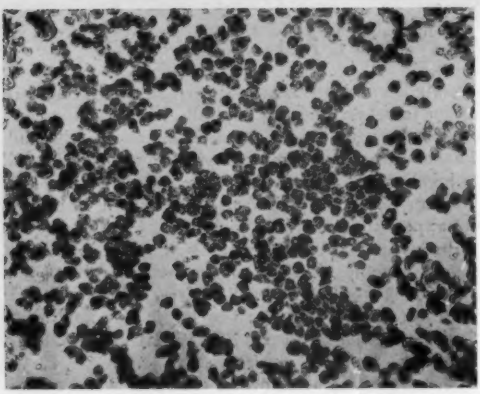

FIG. 1. Whole liver cells prepared from liver perfused with 0.027 *M* sodium citrate in calcium-free Locke's solution. Homogenization and purification carried out in calcium-free Locke's solution.

sum of the whole cells and the calculated broken cells.

The results obtained with preparations made from 25 rats are shown in Table 1. In the first two experiments shown (citrate), omission of back perfusion via the hepatic vein probably accounts for the low yield. Back perfusion with a pressure of 120 cm of water distends the liver considerably and appears to help separate the liver cells. However, similar back perfusion with complete Locke's solution did not increase the whole-cell yield. Although no extended experiments using rats of different ages have been made, it appears that older rats (350 g) give lower yields of whole cells.

Citrate, pyrophosphate, Versene, and ATP were all almost equally effective; glycerophosphate was less efficient in preventing cell breakage. Considerable variation in whole-cell yield in different preparations made with the same perfusion medium were noted.

Purified suspensions were prepared by sedimenting the whole cells by centrifuging 4 min at $110 \times g$ at 0° C, resuspending in calcium-free Locke's solution and resedimenting twice, using the same centrifugal field. A preparation prepared by perfusion with 0.027 *M* citrate is shown in Fig. 1.

The practical advantage of using suspensions of whole cells in place of slices are many and have been previously discussed by Elliott and Libet (*14*). It should be emphasized, however, that numerous alterations may well have occurred during the procedures described here, and the synthetic potentialities of such free cells may well differ considerably from those in the intact organ. It should be noted that Versene has recently been found to prevent the decline in oxidative phosphorylation otherwise seen in isolated heart mitochondria (*15*) and may have a similar effect here.

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Purification and Crystallization of Hyperglycemic Glycogenolytic Factor (HGF)

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Murlin *et al.* in 1923 (*1*) first noted a hyperglycemic response obtainable with certain pancreatic extracts and suggested the name glucagon for the causative agent. Interest in material causing hyperglycemic action was increased by the finding that insulin preparations exhibited a hyperglycemic response which appeared as an initial and transient hyperglycemia following intravenous administration of the insulin preparation (*2, 3*).

Several workers (*2, 4*) have attempted unsuccessfully to isolate a highly purified material responsible for hyperglycemic action either from pancreas or from commercial amorphous insulin. In this communication we report the preparation of a novel crystalline compound (HGF) having a high degree of hyperglycemic activity.

Precautions were exercised in the isolation procedure to avoid steps involving denaturation or inactivation of contaminating proteins, principally insulin. In this way it was possible to use insulin assays to follow the removal of this particular contamination in various preparations made in the course of the work. The utilization of mild procedures also prevented decomposition of the hyperglycemic material.

The hyperglycemic activity was determined by noting the increase in blood sugar after intravenous injection of the test material into anesthetized cats. Blood sugar was determined on blood samples withdrawn at 5-min intervals during the first 25 min after the injection.

An amorphous fraction obtained during the com-

[1] We are pleased to acknowledge the assistance of H. J. Wick in providing the determinations of biological activities, and of H. A. Rose in photographing and characterizing the crystals.

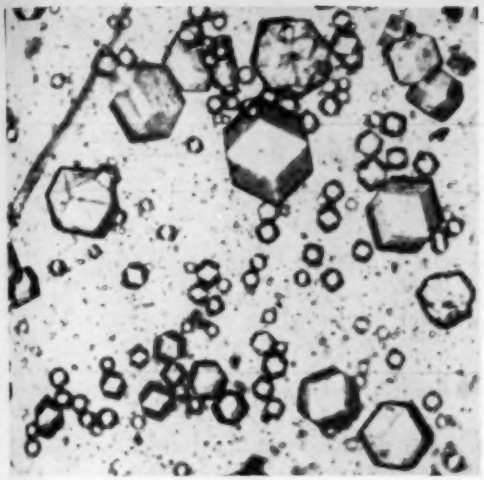

FIG. 1. Crystalline HGF.

mercial purification of insulin served as starting material. An initial precipitation at pH 6.7 yielded a material of considerable hyperglycemic activity and relatively free of insulin. Additional purification was achieved by collecting the fraction that separated between 50 and 76% acetone. Successive fractional precipitations at controlled pH in acetate and phosphate solutions resulted in a highly purified preparation that was relatively soluble in water but largely insoluble in presence of electrolytes. Administration of 0.15 μg/kg body weight of this material into cats gave a 30 mg% increase in blood sugar. A solubility curve indicated that the preparation was about 70% pure. Carboxyl-terminal amino acid analyses performed on the purified sample according to the method of Akabori (*5*) yielded essentially a single amino acid.

The highly purified preparation was dissolved in a buffer solution at alkaline pH. The precipitate obtained after centrifugation at 64,000 g was removed, and the supernatant solution was allowed to stand in the refrigerator overnight. Figure 1 shows a photomicrograph of crystals formed under these conditions.

The crystalline material is relatively insoluble in cold water and gives positive biuret, Folin-Ciocalteu (phenol reagent), and Sakaguchi tests. The ultraviolet absorption curve shows a maximum at 278 mμ and a minimum at 250 mμ. The crystals belong to the isometric system and appear as rhombic dodecahedra. They contain only traces of zinc. Biological activity of the crystalline material was determined in both cats and rabbits. Results of these tests are presented graphically in Fig. 2.

Chemical and physical chemical properties, amino acid composition and analyses, and other characteristics are currently being determined with the crystalline material. This work along with detailed procedures for isolation will be published elsewhere.

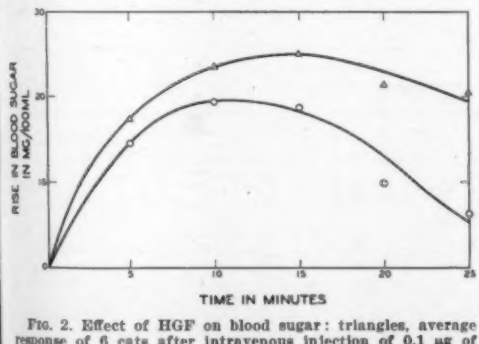

FIG. 2. Effect of HGF on blood sugar: triangles, average response of 6 cats after intravenous injection of 0.1 μg of HGF/kg body weight; circles, average response of rabbits after intravenous injection of 1.5 μg of HGF/kg body weight.

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Failure of Cyanide to Inhibit β-Amylase

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According to Roy and Underkofler (*1*), treatment of malt extracts with 0.1% sodium cyanide at 30° for 1 hr had no effect on the α-amylase activities but lowered the saccharogenic activities of these extracts; NaCN completely inhibited the β-amylase activities of extracts from wheat, barley, and soybean, and of solutions of commercial β-amylase. The apparent survival of β-amylase activities in the malt extracts, according to them, was due to the limited dextrinase activities which resisted the cyanide treatment. In their experiments no attention was paid to the pH of the cyanide-treated enzyme solutions. Sodium cyanide is a strong base, and it can easily be supposed that the pH values of the NaCN-treated enzyme solutions would shift far to the alkaline side of the reaction. Furthermore, it is well known that in nonspecific inhibition the degree of inhibition is dependent on the relative concentrations of inhibitor and active centers in the enzyme molecule. From the foregoing considerations, it seemed of interest to reëxamine the effect of cyanide on the α- and β-amylase activities of various origins.

Potassium cyanide, in place of sodium cyanide, was used in this experiment. The control test was run simultaneously without added inhibitor, and tests were made with 0.1% HCN (neutralized to pH 5.0) and with 0.1% potassium carbonate, respectively. Potas-

TABLE 1

EFFECT UPON AMYLOLYTIC ACTIVITY OF PRETREATING AQUEOUS EXTRACTS OF MALT AND TAKA-DIASTASE WITH 0.1% HCN, KCN, OR K_2CO_3*

Sample	Protein content	α-Amylase activity				Total saccharogenic activity			
		Control	Treated with 0.1%			Control	Treated with 0.1%		
			HCN	KCN	K_2CO_3		HCN	KCN	K_2CO_3
	mg/10 ml pretreating mixture								
Malt	43.7	37.0 (6.61)	37.0 (5.91)	37.0 (10.12)	37.0 (8.55)	18.8	21.1	20.5	21.8
	4.86	33.3 (6.26)	33.3 (5.55)	33.3 (10.83)	33.3 (10.46)	16.8	19.4	2.75	2.00
Taka-diastase	1.38	10,000	8,000	2,900	2,000				
	0.05	12,000	10,000	2,000	1,670				

* The pH values of the pretreating mixtures are indicated in parentheses. Enzyme activities are expressed in arbitrary units per milliliter of enzyme solution.

sium carbonate was used to examine the effect of pH on the amylolytic activities of these enzymes. Concentrations of cyanide were determined by the titrimetric method of Liebig (*2*). α-Amylase activities were determined essentially by the method of Sandstedt *et al.* (*3*) with some modifications. β-Amylase activities were determined by the method of Nakamura *et al.* (*4*), the principle of which depends on the determination of the initial velocity of the liberation of reducing sugars from starch during the amylolytic reaction. Enzyme activities were expressed in arbitrary units per milliliter of the enzyme solution.

The enzyme preparations employed in this investigation included those obtained from malt, grains, sweet potatoes, and a commercial taka-diastase preparation. Ten grams each of malt, grains, and taka-diastase finely ground in a mill were treated with 90 ml of water for 1 hr at 37° with frequent shaking. The mixtures were then centrifuged and filtered. Sweet potatoes were ground on a porcelain grinder and pressed through a cotton cloth. The pressed juice was centrifuged and filtered. Purified sweet potato β-amylase was a preparation corresponding to the "purified concentrate" in the purification procedure of Balls *et al.* (*5*). Where cyanide and carbonate treatments were employed, 1 vol of 1% aqueous solutions of these inhibitors was added to 9 vol of the enzyme solutions to make 0.1% concentration of the inhibitor, and the mixture was held for 1 hr at 37°. After the treatment, the enzyme activities were determined at 37 ± 0.1°.

The results showing the effect of these treatments upon the α- and β-amylase activities of respective enzymes are given in Tables 1 and 2, respectively. Treatment of malt extracts with 0.1% KCN for 1 hr had no effect on the α-amylase activities but lowered the saccharogenic activities of these solutions. This treat-

TABLE 2

EFFECT UPON β-AMYLASE ACTIVITY OF PRETREATING VARIOUS SAMPLES WITH 0.1% SOLUTION OF HCN, KCN, OR K_2CO_3

Samples	Protein content	β-Amylase activity			
		Control	Pretreatment of the enzyme solution with 0.1%		
			HCN	KCN	K_2CO_3
	mg/10 ml pretreating mixture				
Wheat (an unknown strain)	27.1	22.2	25.3	1.30	
Wheat (Nôrin, No. 69)	18.3	17.3	17.3	0.29	0.59
Barley (Sekitori, No. 1)	36.2	27.1	26.9	10.0	18.0
	4.02	27.4	27.8	1.9	1.2
Soybean (Nôrin, No. 2)	275	53.7	53.0	52.7	58.4
	30.6	57.5	53.6	53.5	47.7
Sweet potato (Nôrin, No. 1)	17.2	494	465	429	442
	1.15	403	434	3.4	12.4
Sweet potato (Kintoki)	19.9	165	173	151	164
	1.33	166	171	13.5	7.5
Purified sweet potato β-amylase	0.77	125	157	122	116
	0.08	107	141	9.0	3.0

ment had marked decreasing effect on the α-amylase activities of taka-diastase extracts, and on the β-amylase activities of extracts from ungerminated wheat, barley, soybean, and sweet potatoes, and of solutions of purified β-amylase from sweet potato. This decreasing effect was dependent on the source of the enzyme as well as on the amount of enzyme protein in the treating mixture. Treatment of these enzyme solutions with 0.1% HCN (adjusted to pH 5.0) had no decreasing effect on either α- or β-amylase activities. Potassium carbonate in 0.1% concentration showed approximately the same degree of inhibition on these enzyme solutions as compared with 0.1% KCN. Moreover, these two reagents caused approximately the same degree of pH shift in the treated enzyme solutions.

These results support the view, in contrast to that of Roy and Underkofler, that cyanide has no inhibitory effect on either α- or β- (or saccharogenic) amylase activities of enzyme solutions used in this investigation. The apparent inhibitory effect of sodium cyanide, which Roy and Underkofler observed in their experiments, may be the result of the combined effects of pH and concentration of enzyme on the pH-heat stability properties of the enzyme solutions.

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Caloric Intake in Relation to Physique in Children[1, 2]

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It has become axiomatic today that obese children eat too much, and that linear children do not eat enough. Efforts have been made and much money has been spent by the parents of these children to change their physiques, but evidence that the results have not been satisfactory has been accumulated. On the contrary, these efforts have merely aggravated the problem and have made it even more difficult to treat. It seems pertinent, therefore, to determine to what extent the physique of the children is due to overeating and undereating, and to what extent it is due to genetic and/or other determining factors. The purpose of this study is to see whether there is a difference in caloric intake in children of different physiques. The children enrolled in the Child Growth Clinic of the Forsyth Dental Infirmary were used as subjects for this study.

Caloric intake and body build were determined for 86 subjects, selected from 350 enrolled in the aforementioned clinic, in order to obtain representatives of each physique, ranging from extremely lean to extremely fat children. Physiques were determined according to Sheldon's method. He classifies physique into three categories: (*a*) endomorphy, the stocky or obese; (*b*) mesomorphy, the muscular; and (*c*) ectomorphy, the linear or "skinny." Sheldon's contention is that all individuals have a measure of all three components, but that in the vast majority there is a degree of dominance of one of these three components which determines in which of the three categories the individual belongs (*1*). The group of 86 subjects studied consisted of 28 endomorphs, 21 mesomorphs, and 37 ectomorphs.

For each child the following was done: (*a*) height and weight were recorded; (*b*) dietary data for one week were obtained; and (*c*) the pediatrician examined each child.

The ages of these children ranged from 6 to 14 years, the mean of the group falling into the ten- to twelve-year category. Both sexes were included, although the majority were female. The physical examination of these children in the clinic revealed no evidence of pathosis.

The dietary data of these subjects for a period of one week were recorded by their mothers. The calories and amounts of proteins ingested were then calculated, and a 1-day average was computed from the 7-day data for each child.[4] The 1-day averages for each child were compared with the National Research Council standards (*2*) for a child in the appropriate age group. The results for each child were expressed as a percentage of National Research Council standards and the 1-day averages.

The mean and standard deviations of the dietary intake of each group were computed, and statistical tests for the significance of difference (t) between the endomorphs, mesomorphs, and ectomorphs were made.

As shown in Table 1, there are distinct differences in the ranges of caloric intake (expressed as a percentage of National Research Council requirements) of the three physique groups. The mean and standard deviations of each group are shown in Table 2.

Tests of the significance of difference (t) between the three groups were made, and the results are shown in Table 3. The t for the endomorphs versus the mesomorphs is probably significant, and the t for the endo-

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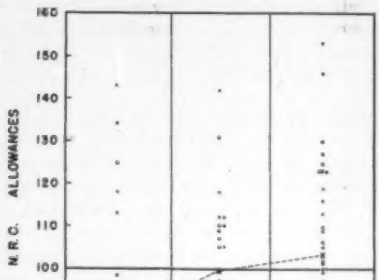
[4] Seasonal variations in the dietary intake were accounted for by the fact that all these children were seen either in the spring and fall, or in the winter and summer. Dietary data were obtained at each of these visits to the clinic.

TABLE 1

DISTRIBUTION OF CALORIC INTAKE ACCORDING TO PHYSIQUE



morphs versus the ectomorphs is highly significant.

In considering these findings it must be recognized that the dietary questionnaire may have introduced sources of error. Since household measures were used, corrections for loss of nutrients in preparation were not made. Parental or subject reporting is generally far from perfect; however, it was found that (*a*) no completely implausible results were obtained, (*b*) the results obtained could not be explained by random error, and (*c*) retests showed a high degree of reliability.[5] Hence it was felt that the questionnaire method was satisfactory and did not influence the findings unduly (*3, 4*). Another question was whether the parents consciously understated the caloric intake of the stocky children and exaggerated that of the linear ones. This is unlikely for the following reasons: (*a*) all these children and their parents had been coming to our clinic for many years (3–5 yr) and were known to be extremely truthful, and furthermore any deliberate change in the dietary would have been noted; and (*b*) the unexpected pattern exhibited by the data would not have occurred had fabrication been the rule.

For most of the subjects the protein intake was adequate.

In spite of the possible weaknesses in the questionnaire method, the relation indicated by the results is so definite that it cannot be ignored. It is obvious that "obesity" or "leanness" is not accounted for by the same common factor in all children (*5*). The author suggests the operation of the following determining factors: (*a*) inherent, genetically determined differences in food utilization and tendency to deposition of fat (*6*); (*b*) different activity rates, including resting activity and involuntary motion; and (*c*) differences in heat loss relative to body mass, with heat conservation most efficient in individuals with lowest mass/surface area ratio (*7*).

[5] Retests were done on 15 of the children used for this study, and the variations in caloric intake did not exceed 1–6% of the initial caloric averages.

TABLE 2

	N	Mean ± S.E.	Standard deviation
Endormorphs	28	87.6 ± 4.7	24.9
Mesomorphs	21	99.8 ± 4.1	18.7
Ectomorphs	37	103.5 ± 3.1	18.8

TABLE 3

TESTS OF SIGNIFICANCE

	(*t*)	Degrees of freedom	Probability
Endomorphs vs. mesomorphs	1.96	47	0.05 (probably significant)
Endomorphs vs. ectomorphs	3.00	63	0.01 (significant)
Ectomorphs vs. mesomorphs	0.74	56	0.40 (not significant)

There is other evidence that, on an individual basis, obesity can be caused by overeating, and leanness by the reverse. On a group basis this explanation is not sufficient. The observed caloric intake of each of these groups relative to body build is actually in the opposite direction from the expected pattern. What is important is that differences of body build in children are not a function of caloric intake alone.

Of the child population at large it is already known that differences in energy expenditure occur within a surprisingly large range, such as those expressed by differences in sleeping habits and marked differences in heat exchange. The stout, or more endomorphic, children can be expected to expend fewer calories because of less surface area exposed, and, if they also sleep more than the linear, more active children, several hundred calories per day are conserved (*8, 9*).

This study indicates that the observed caloric intake of each of these groups relative to body build is actually in the opposite direction from the expected pattern.

Although these findings throw important additional light on the problem of weight control, they also tend to intensify it. In other words, the standard reducing diet of 1000–1500 calories/day given to an endomorph would not reduce his weight. In order for him to reduce he would have to resort, at least initially, to a caloric intake of only 700–900 calories/day, in which case he would not be meeting the National Research Council requirements for specific nutrients.

This dilemma becomes even more obvious when applied to children. Of necessity, a child's diet is higher in calories than an adult's because the requirements for specific nutrients are higher, and decreasing the dietary even to 1200–1500 calories/day would mean going below the National Research Council requirements. Children cannot afford a drastic reduction in calories because of their need of these foods for growth and development.

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Protection Against X-rays and Therapy of Radiation Sickness with β-Mercaptoethylamine[1]

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Many substances *in vitro* partially inhibit the action of ionizing radiations on substances in aqueous solution. This fact has been correlated with the theory of indirect action through free radicals (*1–3*). The substances that were first shown to have a protective action against x-rays in animals, were toxic or had too weak an action; such is the case with thiourea, cyanide, malononitrile and azide (*4, 5*), nitrite (*6*), estradiol (*7*), cysteine and glutathione (*8*), and pyruvate (*9, 10*).

During a systematic search for a substance suitable for use in human beings, we encountered many protective substances in the amine group. Very active, but also toxic, are tryptamine, 5-hydroxytryptamine (=serotonine), para- and meta-tyramine, and dopamine (*10, 11*). The amino acids have, in general, a weak protective action in mice, a confirmation of the results of Hollaender and his group with microorganisms (*12*); the corresponding amines are generally better protectors (*10, 11*). Cysteamine $HS—CH_2—CH_2—NH_2$ (=β-mercaptoethylamine=1573 L.=Becaptan R.N.) and the corresponding disulfide (=cystinamine), are in our opinion, the most interesting substances so far discovered, because of the power of their action and their low toxicity.

Cysteamine is a fragment of coenzyme A. Cystinamine, $\begin{matrix} S—CH_2—CH_2—NH_2 \\ | \\ S—CH_2—CH_2—NH_2 \end{matrix}$, like many diamines, is a liberator of histamine (*13*) and for this reason cannot be advocated for internal use in man. Thus our attention had been focused on cysteamine.

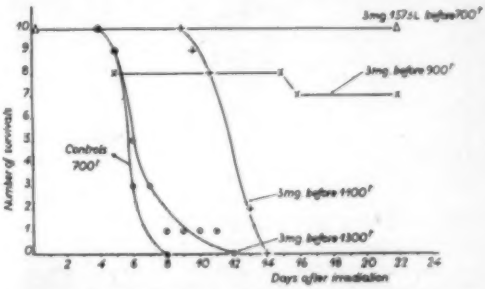

FIG. 1. Ordinates, number of mice (out of groups of 10) surviving after irradiation at day 0. Abscissae, days after irradiation. Various doses of x-rays (700 r–1300 r) are given to mice injected with 3 mg cysteamine, and the mortality compared with that of controls which receive 700 r.

Protection of mice against x-radiation. Mice of pure breed (C 57 black), about 4 months old, weighing 19 to 21 g, are irradiated by groups of 10 in a pasteboard box: 250 kv, Cu 2.5 mm, focal distance 50 cm, field 100 cm², 90 r per min. A single dose of 700 r kills practically all our controls in 5–15 days. Out of 38 series of 10 control mice, only 7 animals were alive 25 days after irradiation.

If a dose of 3 mg of cysteamine (base, neutralized with HCl to pH 6.5) is injected intraperitoneally 1–3 min before irradiation (700 r), a permanent survival of 97% is observed; it is necessary to give about 1300 r in order to obtain, in mice protected by cysteamine, the same mortality curve (Fig. 1). If it is injected 0.5–3 min after the end of irradiation, it does not affect the mortality. Cysteamine is rapidly metabolized; the mice irradiated 1 hr after the injection of cysteamine behave about like the controls. Cysteine (HCl) injected in doses equimolecular to 3 mg of cysteamine allows only 3 animals out of 10 to survive a dose of 700 r. The white cell count of irradiated mice protected with cysteamine drops just like those of the controls during the 2 or 3 days following irradiation, but recovery starts earlier in the injected animals. Similarly, the weight of protected mice, like that of the controls, decreases for 2 days after irradiation, but on the third or fourth day, the weight of the injected animals begins to increase (Fig. 2), whereas the weight of the controls drops until death.

The protective action of cysteamine against x-rays

[1] Under the auspices of the "Conseil Supérieur de la Sécurité Civile Ministère de l'Intérieur," Brussels.

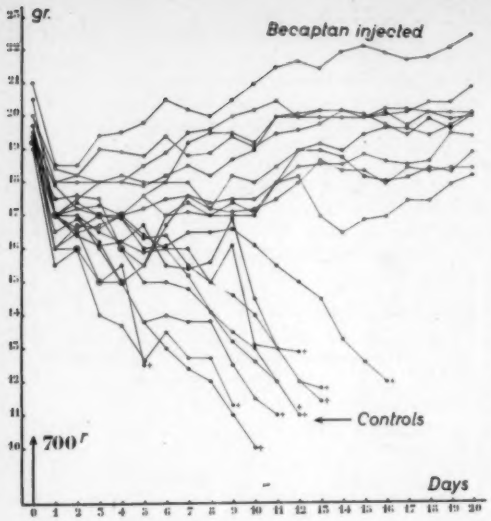

FIG. 2. Ordinates, weight in grams of 20 mice, 10 of which have been injected with cysteamine (3 mg intraperitoneally) before irradiation (700 r), 10 others serving as controls. Abscissae, days after irradiation. All the animals lose weight during the first day; there is progressive recovery of the injected animals (which survive), whereas the weight of the controls drops until death.

is a general one: it protects ciliates (*14*), reticulocytes of dog blood *in vitro* (*15*), and growing roots of peas (*10*), as well as mice or rats.

Preliminary histological examinations confirm that the primary radio-lesions are similar in both the irradiated-protected and the control mice, but regeneration is much more rapid and vigorous in the protected animals. Female mice surviving a dose of 700–1000 r, when protected by cysteamine or cystinamine, are permanently sterile. The ovaries are destroyed, and it is difficult to find a single follicle. The hair also shows progressive graying (*16*).

For cysteamine, we are inclined to accept the interpretation given by Cronkite, Brecher, and Chapman (*17*) for the protective action of glutathione. Regeneration mechanisms or factors (possibly we should add coenzyme A) would not be so heavily damaged when the organisms are irradiated in the presence of a molecule that competes for the free radicals liberated during irradiation. But cysteamine has other actions that are not explainable by the simple hypothesis of the *protection* of a regeneration factor.

Therapeutic action in radiation sickness. A single intravenous injection of 200 mg cysteamine (base, neutralized by enough HCl to obtain pH 6–7) is often sufficient to eliminate, in 24 hr, the symptoms of radiation sickness (nausea, vomiting, diarrhea, general weakness, etc.) observed in cancerous patients treated with ionizing radiations. Sometimes 2—rarely 3—injections are needed to obtain a full therapeutic effect. Many observations in Liége, and the various cancer centers in Belgium have confirmed the preliminary report of Herve (*18*) and have shown that there is no danger of tumor cells becoming refractory to ionizing radiations.

Mercaptoethylamine salicylate is the only nonhygroscopic salt thus far obtained that is stable in air. It is a white crystalline substance, melting point 104–105°, highly soluble in water and alcohol, insoluble in ether and petroleum, slightly soluble in chloroform. It is very effective when given by mouth in gelatin capsules (300 mg 3 times a day) to irradiated cancerous patients experiencing typical radiation sickness. At first glance there seems to be a contradiction between this fact and the observations summarized above. Obviously, the action of cysteamine on radiation sickness is not explainable on a simple physicochemical basis (competition for free radicals), because in this case the substance is injected *after* irradiation and changes a general syndrome affecting tissues that have not been irradiated (actions *à distance*). Preliminary obsérvations on the metabolism of mercaptoethylamine, and on the reactions of the body to that substance, seem to show the way to a possible interpretation.

Metabolism. Both cysteamine (SH) and cystinamine (S—S) disappear from the blood in 20–30 min when injected intravenously in large amounts (up to 75 mg/kg) in dogs and rabbits. Cystinamine is reduced *in vivo* to cysteamine, as shown by the appearance of titrable —SH functions in plasma and urine, and by paper chromatography and polarographic analysis. *In vitro,* when cystinamine is put in contact with cysteine at neutral pH and room temperature, a precipitate of cystine appears in a few minutes (*19*). Therefore, we think that the main function of intracellular thiol groups of glutathione and proteins, may be to keep coenzyme A in reduced condition.

About 35% of intravenously injected cysteamine is excreted unchanged by the kidneys. After cysteamine injection large quantities of ascorbic acid and other, unidentified reducing substances not bearing thiol functions, appear in the plasma of rabbits and in the urine of dogs and man. Table 1 summarizes some observations (see also *19*). It must be clearly understood that by ascorbic acid we mean a substance without —SH, reacting with dichlorophenolindophenol. In some cases, polarographic and spectrographic analysis have given clear indications that ascorbic acid is the main substance involved. The ascorbic acid content of the suprarenal glands of rats drops to about 35% of normal 4 hr after intraperitoneal injection of 10 mg per 100 g cysteamine. There is no change in the cholesterol content of these glands, the number of circulating eosinophiles does not drop, and there is no increased urinary excretion of corticoids. Thus, cysteamine has no ACTH-like action, although large quantities of ascorbic acid disappear from the suprarenal glands (*20, 21*).

Cysteine in equimolecular doses does not liberate reducing substances in the plasma of rabbits.

TABLE 1

ASCORBIC ACID IN PLASMA AND URINE OF ANIMALS AND MAN AFTER INTRAVENOUS INJECTION OF CYSTEAMINE

Animal	Weight in kg	Dose injected in mg of base	Fluid examined	Time after injection	Concentration of ascorbic acid µg/ml	Total ascorbic acid excreted, mg
Rabbit	1.9	200	Plasma	0	3.6	
				1 min	2.2	
				5 "	3.8	
				15 "	5.4	
				45 "	10.4	
				55 "	9.8	
Rabbit	2	200	Plasma	0	4.4	
				1 min	4	
				5 "	4.2	
				15 "	8.2	
				45 "	9.4	
				75 "	10.5	
				90 "	4.2	
Dog	9.5	300	Urine	1 hr before		0.80
				1 hr after		2.88
				2 hr "		2.73
				3 hr "		4.38
				4 hr "		4.92
				5 hr "		3.27
				6¼ hr after		3.71
				7¼ hr "		3.10
Man	65	500	Urine	0	5.7	
				15 min	35.2	
				2 hr	32.6	
Man	68	200	Urine	1 hr before		0.058 µg
				1 hr after		0.098 "
				2 hr "		0.297 "
				3 hr "		0.070 "
				4 hr "		0.081 "

Actions on the liver. Many facts indicate that the liver is the site of important reactions to ionizing radiations and cysteamine:

1) Chevallier (*22*) has observed that, if 25–50 r are given daily to rats, they die, when they have received a total dose of 2500–3000 r, from fatty degeneration of the liver.

2) Maisin *et al.* (*23*) have shown that mercaptoethylamine is effective in rats when given *after* irradiation, if the liver has been protected by lead. A typical series of experiments shows: (a) 24 rats given 1130 r without any protection were all dead on the 8th day. (b) 24 rats similarly irradiated, which received 3 intraperitoneal injections of 7 mg cysteamine (the first immediately after irradiation, the second 6 hours after irradiation, and the third 12 hours after irradiation), were also dead on the 8th day. (c) Out of 24 rats that received 1130 r with the liver (but not

TABLE 2

CONTENT IN ASCORBIC ACID (µg/g) OF THE LIVER OF C 57 BLACK MICE (19–21 g) INTRAPERITONEAL INJECTION OF 3 MG CYSTEAMINE (BASE)

Controls	After injection							
	15 min	45 min	2 hr	3½ hr	4 hr	5 hr	6½ hr	28 hr
197								
200	200	271	256	292	283	314	223	220
191	211	244	271	241	288	315	243	225
210	220	246	267	290	274	231	240	
204								
206								
190								
180								
192								
Mean 197	210	254	265	274	282	303	235	

the spleen) protected, 16 were still living on the 8th day, but only 5 on the 30th day. (d) Out of 24 rats that received 1130 r with the liver protected and 3 injections of becaptan as in (b) (i.e., *after irradiation*), 14 were living and in excellent condition 30 days after irradiation. If another part of the rat's body (a hind limb, for instance) is protected, cysteamine does not decrease mortality if given after irradiation.

3) Becaptan reduces the weight of the liver in mice, and increases its content by 50% in ascorbic acid (Table 2, Fischer and Bacq, unpublished).

Other actions. β-Mercaptoethylamine has a peculiar antimitotic action on tissue cultures of chick embryo. It seems to act mainly on the cytoplasm of cell in interkinesis; the nucleus divides, but the cytoplasm does not; thus binucleated cells are formed (*23*).

Large doses of cysteamine (up to 1 g daily, for 15 days) have been given intravenously in 11 cases of chronic leukemia, with good results in 4 cases. Cysteamine does not change the basal metabolic rate and has no antithyroid action (*21*). It inhibits the tuberculinic reaction in the skin of sensitized humans and increases the time necessary to observe the trypan blue color in the skin of rabbits after local chloroform application, about 500% (Ambrose and de Eds test) (*24*). It also inhibits the allergic passive Arthus reaction in the skin of rabbits.

Conclusion. At the present time β-mercaptoethylamine (= cysteamine) thus seems to be the most practical substance to protect mammals against ionizing radiations. It remains active when given after irradiation, if the liver has been protected. It has a remarkable therapeutic action against radiation sickness in cancerous patients locally irradiated. Other observations show that mercaptoethylamine is a molecule of great biological interest, the study of which is being actively pursued in our laboratories.

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Incorporation of Tritium Oxide Into Growing *Chlorella pyrenoidosa* Cells[1]

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It is well established that water is the source of hydrogen in green plants and that photosynthesis is the mechanism whereby the hydrogen is incorporated. Presumably, tritium (H^3) should follow the same pathway in plants and should be incorporated at the same rate as ordinary hydrogen, if no isotope effect exists. From the work of Reitz and Bonhoeffer (*1*) with deuterium, however, it appears that an isotope effect should be expected with tritium, for these workers found that *Scenedesmus acutis* and *Chlaymdomonas spp.* incorporated deuterium in the nonexchangeable portion of growing algae to the extent of only 30 to 70% of its concentration in the nutrient solution. Deuterium oxide concentrations of 12 to 47% were used.

In the experiments to be described algae were grown under standard conditions for varying periods of time. The cells were harvested, and determinations were made of dry weight, and of hydrogen and tritium content. The results were expressed as mc of tritium per ml of water of combustion of the dry cells. The values were then plotted against the number of weight doublings of the original cells, and comparisons were made with a theoretical curve derived on the assumption that no isotope effect exists. Details of the experimental procedure follow.

The green alga, *Chlorella pyrenoidosa*, was used. The culture, obtained from the American Type Culture Collection, was grown on agar slants enriched with sucrose, and transfers were made at monthly intervals. Algae to serve as inocula in experiments were transferred to a sucrose enrichment culture and then, after growth had taken place, to the completely

[1] This work was performed under Atomic Energy Commission Contract No. W-31-109-Eng-52.

[2] The authors are indebted to the Analytical Unit of the Biology Division for the tritium analyses and to Mrs. M. Newcombe of the Analytical Services Unit, Technical Division, for the hydrogen analyses.

inorganic nutrient solution of Knop (modified). After a growing period of 4 to 7 days under fluorescent light of 300–500 footcandles with aeration by a stream of 10% CO_2 in air, the algae were withdrawn for use. They were centrifuged and subsequently resuspended in sterile water for inoculation.

Experimental algae were grown in test tubes as suggested by Myers (*2*). Twenty-five by 150 mm tubes were partially filled with nutrient solution, plugged with cotton, and sterilized by autoclaving. The iron solution was sterilized separately and added to the other salts. Tritium oxide was added to give a concentration of 1 mc/ml in most experiments. (Control experiments indicated that this level of tritium was not inhibitory to algal growth.) Inocula were in the log period of growth, and they were added in amounts of 0.02–0.12 mg dry weight of cells/ml of nutrient. (Optical density was used as a measure of the initial concentration (solids) of algae and as a measure of growth attained during and at the end of an experiment. Other experiments had shown a linear relationship between cell mass and light absorption.) Throughout the growth period of the experiment a mixture of 10% CO_2 in air was bubbled into the solutions through sterile 0.5-mm capillary tubing, and the cells were exposed to light of approximately 500 footcandles, supplied by 36-in. fluorescent tubes. The temperature of the solutions was maintained at 25 ± 3° C.

The algae were harvested at intervals within the range of 0.1–8.0 doublings in weight. Light absorption readings were made, and the cells were then centrifuged at approximately 8500 rpm for 2 min. The cells were resuspended in distilled water and then centrifuged. This procedure was repeated twice. (While this procedure will remove some exchangeable tritium from the cells, the amount so lost was shown to be less than 6% of the total tritium present in the cells.) The washed cells were vacuum dried; then they were combusted over copper oxide in a conventional macro furnace. A circle of filter paper was added to the sample to increase the volume of water collected. Combustion water was collected in a U-tube trap cooled with a dry ice-ethanol mixture. Tritium analyses were performed on aliquots of the combustion water. Details of the counting procedure and equipment have been described by others (*3*). Total combustion water was determined on separate samples by the standard microanalytical procedure for hydrogen.

The organically bound tritium content of the algae, expressed as mc/ml of combustion water, is plotted (Fig. 1) against the number of weight doublings of the cells. The number of doublings was calculated from the following equation (adapted from Porter [*4*]):

$$n = 3.3 \log b/B$$

where n = number of doublings in weight, b = weight at the end of an experiment (optical density), and B = weight at the beginning of experiment. A curve showing the theoretical amount of tritium expected in the cells, assuming no isotope effect, is also shown

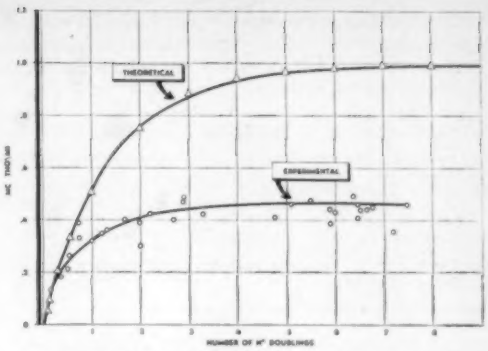

FIG. 1. Uptake of tritium oxide by rapidly growing *Chlorella pyrenoidosa*.

in Fig. 1. The theoretical curve was derived on the assumptions that: (1) all newly formed algal material would incorporate tritium and protium in the same ratio as that present in the nutrient solution; (2) tritium would not replace hydrogen, in significant quantities, in the organic compounds of the inoculum; and (3) hydrogen of the original inoculum would not be lost in significant amounts through metabolism.

Figure 1 shows that after one or two weight doublings of the algae the amount of tritium incorporated is much less than that predicted on the assumption that no isotope effect exists. These results clearly show that tritium is moved more slowly than hydrogen along anabolic pathways of growing algae, and further, they show that the rate for tritium incorporation is between one-third and one-half that for hydrogen. Why the isotope effect is not apparent or as great before one or two weight doublings is not clear at this time. It is quite possible, however, that one or more of the assumptions made in constructing the theoretical curve may not be completely valid during the time the cells of the inoculum first double in weight.

A study has been made of the effect of tritium concentration in the nutrient solution on the relative up-

TABLE 1

TRITIUM CONTENT OF ALGAE GROWING IN MEDIA CONTAINING DIFFERENT LEVELS OF TRITIUM OXIDE

(Results after 5.5 doublings of weight)

Tritium in medium (mc/ml)	Tritium in Combustion Water		Per cent of theory
	Theoretical (assuming no isotope effect) (mc/ml)	Experimental (mc/ml)	
0.01	0.00975	0.00481	49
0.05	0.0488	0.0231	47
0.10	0.0975	0.0442	45
0.25	0.244	0.114	47
1.00	0.975	0.452	47
4.00	3.90	1.76	45

take of tritium and protium by the algae. The results are presented in Table 1. They show that approximately the same isotope effect was obtained at each concentration of tritium.

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Extended-Range High-Frequency Radio Communication at Relatively Low Power, by Means of Overlapping Oblique Reflections from Meteor Ionization Trails[1]

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At radio frequencies customarily used for long-range radio communication (6–25 mcs), the following mechanisms are known whereby reasonably consistent signals can be propagated from transmitter to receiver: (1) ground wave, (2) space wave, (3) anomalous tropospheric propagation, (4) ionospheric sky wave, reflected by both regular and "abnormal" layers, and (5) indirect sky-wave transmission, involving backscattering from the earth (*1*). Recently, a new type of transmission explained as ionospheric forward scattering has been demonstrated at a frequency of 50 megacycles, with the aid of transmitting equipment of relatively high power (order of tens of kw), and antennas of high gain (*2*).

It is the purpose of this note to suggest that at frequencies of the order of 15 megacycles and lower, still another mechanism may largely account for a consistent type of propagation which has been found to exist between low-power stations (order of 1 kw) separated by distances of roughly 800 miles. The mechnism proposed is that of overlapping reflections from the large numbers of meteor ionization trails which are present in the E-region of the ionosphere at any given time.

It has been predicted on theoretical grounds (*3*), and demonstrated experimentally to a first approximation (*4*), that the duration of an echo from the most common type of meteor trail is considerably increased when the reflection takes place at oblique, rather than perpendicular incidence. A perpendicular-incidence echo decays in intensity and falls below the threshold of detection not because the causative ionization has disappeared, but rather because contributions to the echo from various portions of the expanding cylindrical disturbance begin to cancel each other out as soon as the separation between any two portions approaches a half wavelength. The onset of this cancellation is considerably delayed when oblique geometry is involved, because the trail must expand further before the pertinent portions become separated by an amount which produces a half-wavelength change in length of path.

The numbers of meteors detectable at vertical incidence at 15 megacycles with continuous-wave powers of the order of one kw, is such that the individual meteor echoes are usually well separated in time.

Over an oblique path of the order of 800 miles, however, the mean duration of received echoes may be expected to be considerably lengthened. For the most favorably situated trails, the increase may be as much as 20 times. When the pertinent statistical and geometrical factors are taken into account, the probability of at least one echo of detectable strength being present at any given time can be shown to be very high.

In order to verify this expectation experimentally, it is necessary so to choose the wavelength, time of day, and season of the year that transmission possibilities (4) and (5) above are ruled out. Elimination of possibility (5) is important, since sporadic-E clouds of ionization located to one side of the transmission path of interest (and so not readily detectable as such) can nevertheless make a perceptible contribution to the total signal observed over the desired path by indirect backscattering from the ground. Over a path of 800 miles, at the frequencies of interest, mechanisms (1), (2), and (3) may not be expected to be of significance.

Experiments have been conducted over paths of approximately this length, at a frequency close to 14 megacycles, with possibilities (4) and (5) ruled out with the aid of a scatter-sounding apparatus which has been described elsewhere (*1, 5*). Background transmission, having characteristics consistent with the meteoric echo explanation, has been found on all occasions on which the experiment could be conducted without ambiguity. Transmitted powers of the order of 500 w were used, together with antenna gains of 6–8 db. With standard communications equipment, at locations reasonably free of noise and reasonably favorable to low-angle radiation, a signal well above receiver noise level may be expected at the distant point.

This signal is subject to strong fading. It will be found to dip occasionally into the noise level, yet often rise very far above. It is consistent enough, however, for hand-keyed telegraphy provided that suitable automatic volume control or limiting circuits are used.

Appreciable increases in transmission distance and

[1] This work was in part supported by the Navy Department (Office of Naval Research), the U. S. Army (Signal Corps), and the U. S. Air Force under ONR Contract N6-ONR-251 Consolidated Task No. 7.

transmission frequency have been found to cause the continuous background signal to disappear, leaving only isolated meteor echoes, or bursts.

The practical usefulness of this form of transmission stems from the fact that for point-to-point communication between locations of the order of 800–1000 miles, the possibility of dispensing with the usual procedure of changing frequency two or three times a day in order to follow diurnal changes in the regular layers is offered. If a nominal increase in transmitted power over the value customarily used for layer-propagated transmission over circuits of this sort would be acceptable, it appears that meteor reflections could be relied on to provide usable transmission when other methods had failed. The use of one frequency throughout the 24 hr not only simplifies transmitter design and operation, but also conserves valuable space in the radio spectrum.

The signal obtained in the above-mentioned tests could be accounted for in part as another manifestation of the "ionospheric forward-scattering" suggested as taking place at 50 megacycles (*2*). It is too early to discuss this possibility in detail. However, it is clear that meteors play a very large part in the 15-megacycle experimental observations. On theoretical grounds, it appears that meteors alone could account for the observed signal.

A more detailed account of this work is published elsewhere (*4*).

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Manuscript received November 3, 1952.

Comments and Communications

Rapid Aerial Survey of Gulf Stream with Camera and Radiation Thermometer[1]

During the cold half of the year a sharp discontinuity of surface temperature (often amounting to 20° F in less than 100 yd) occurs along the northern border of the Gulf Stream. The recent discovery (*1*) of meanders in the Gulf Stream has stimulated efforts to devise rapid means for surveying its course, and we (Parson and Stommel) decided to investigate the possibility of tracing the thermal discontinuity on the ocean surface by flying an infrared detector along it.

A Goylay detector (*2*) is exposed alternately to the sea surface and to a reference black body in the instrument by means of a rotating shutter. The temperature of the black body is adjusted by admitting hot or cold water into it until the chopped signal from the Golay cell is nulled. Were there no absorption and emission of thermal radiation by the atmosphere between the cell and the sea, the temperature of the black body would be that of the sea surface. In practice, however, a minimum altitude of 1000 ft is safe over long ocean flights. Enough radiation from the sea penetrates the lowest 1000 ft of the atmosphere to make the sharp thermal discontinuity easily detectible, although the actual temperature of the sea surface is not indicated by that of the black body.

To date three surveys have been made. Positions of the thermal discontinuity on Nov. 26, 1952 are shown in Fig. 1 by dots; the visual evidence of the northern

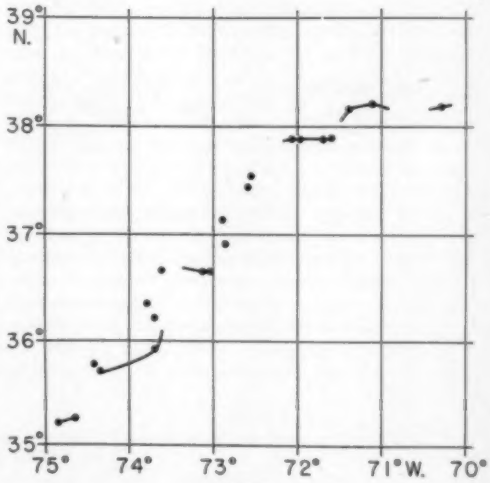

FIG. 1.

edge of the Stream cited by Kielhorn (*3*) (contrast in color and sea-state) was confirmed. A wide angle (80°) time lapse (72 frames/min) motion picture camera directed straight ahead (von Arx) recorded visual evidence of the edge of the Stream at positions marked by segments of curves on the figure. The general appearance of the course of the Stream is similar to that obtained by ship (*4*).

The primary obstacle to extending this type of survey to areas further to the east is the range and endurance of aircraft; but it does seem quite clear that

[1]Contribution No. 597 of the Woods Hole Oceanographic Institution, work supported by the Bureau of Aeronautics and the Office of Naval Research. A Navy PBY airplane carried the apparatus.

an airborne infrared detector is capable of providing an almost synoptic oceanographic chart of surface thermal gradients over a much greater area and in a shorter time than can be obtained using surface vessels.

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Terminology of Pigment Cells

At a conference[1] on the Biology of the Normal and Atypical Pigment Cell we presented our suggestions for the revision of the terminology of pigment cells. The need for this revision has become apparent with the increasing activity in melanin research being carried out by the many investigators in diverse fields.

Investigators in biology and medicine at the present time are using different terms for the same cell. For example, the term melanophore which has long been used by biologists refers to certain dentritic-shaped cells in the skin of fish, amphibians and reptiles which have "contractile" properties. The melanin contained in the melanophores may, in response to certain stimuli, disperse into the dendrites or concentrate in the perikaryon, thus accounting for the color change. In human cytology and pathology the term melanophore is a macrophage. Similarly, the term melanoblast is used by medical investigators for the mature cell elaborating melanin, whereas in biology the term melanoblast refers to an immature pigment cell during its migration from the neural crest. The confusion of terminology is apparent when the terms used by biologists and medical investigators are compared as in Table 1.

TABLE 1

PRESENT TERMINOLOGY OF PIGMENT CELLS

	Biology	Medicine
Mature melanin-forming cell	Melanophore*	Melanoblast†
Immature melanin-forming cell	Melanoblast	No term
Cell with phagocytized melanin	Macrophage	Melanophore
"Contractile" cell	Melanophore	Melanophore

* Melanophore, melanin-bearing cell (*melas* Gr. black; *phore* Gr. to bear).

† Melanoblast, immature melanin cell (*melas* Gr. black; *blast* Gr. germ).

[1] Third Conference on the Biology of the Normal and Atypical Pigment Cell, held in New York, November 1951.

It is noted from the actual translation of the words melanophore and melanoblast that in their present usage these terms do not connote the meaning desired. The term melanoblast for the *mature* pigment-forming cell as originally suggested by Bloch is objectionable because in the modern cytological sense the suffix *blast* is applied to immature cells which differentiate into mature cells (for example, erythroblast, lymphoblast, and leukoblast).

The terms listed in Table 2 represent the consensus of opinion of investigators[2] in melanin research in the United States and Europe.

TABLE 2

RECOMMENDED TERMINOLOGY OF PIGMENT CELLS

Mature melanin-forming cell	Melanocyte
Immature melanin-forming cell	Melanoblast
Cell with phagocytized melanin	Macrophage (or melanophage)
"Contractile" cell	Melanophore

This nomenclature of pigment cells has been adopted by the National Research Council, Committee on Pathology, Subcommittee on Onocology, and is used by contributors to the book *Pigment Cell Growth*, edited by Myron Gordon, Academic Press, New York.

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[2] The following were consulted either personally or by letter: Arthur C. Allen, S. W. Becker, Sr., S. W. Becker, Jr., H. S. Bennett, R. E. Billingham, Helen O. Curth, A. J. Dalton, H. Eastlick, Edward A. Edwards, Peter Flesch, Benson Ginsburg, Myron Gordon, Marie L. Hesselbach, H. Z. Lund, H. S. Mason, P. B. Medawar, Hamilton Montgomery, George Pack, Mary E. Rawles, G. P. DuShane, E. F. Traub, I. P. Trinkaus, Fred Weidman, Helen Wilder, George B. Wislocki.

Miseducation of the Public in Scientific Matters

Today miseducation of the public in scientific matters has become a multi-million dollar industry. As a consequence, all the means of mass communication are being turned upon the public to flood it with "scientific facts" about chlorophyll, about cigarettes, about new drugs, about food, about one's body—indeed, "scientific facts" about almost everything vital to one's very existence.

Unfortunately many of these scientific facts are insidiously concocted by slick advertising copywriters. More are ground out by authors of uncritical, sensationalized magazine articles. Still others are eagerly conveyed by warm, friendly voices on radio and television. Some are invented by novelists and playwrights purely as literary devices. And finally there are the scientific facts poured out by faddists, cultists, pseudo-scientists, and skillfully camouflaged quacks—who sometimes become authors of best sellers.

In 1947 W. Wendell Rázim launched a one-man

campaign in the Metropolitan New York area to provide the public with honest, authentic science information and to combat the kind of miseducation mentioned above. For three years Mr. Rázim worked indefatigably to establish a regular general science radio or television program in this area. For three years he was repeatedly turned away by a total of 17 radio and 7 television stations. But finally by grim determination he won. The result was the radio series *Science for the People,* which made its debut over WEVD on February 3, 1950.

At this writing, *Science for the People* still remains, to our knowledge, the only regular general science radio program directed and produced by anyone in the entire Metropolitan New York area, despite the fact that this area boasts some two dozen radio stations that duplicate many other kinds of broadcasts *ad nauseum.*

In its several years' existence, *Science for the People* has come to enjoy the respect and cooperation of many professional science associations as well as individual scientists and educators. As a consequence it has been able to present well over 100 distinguished scientists and educators in interviews and panel discussions. A list of topics discussed would include cancer, heart disease, polio, surgery, research to prevent blindness, research to prolong youth, care of the teeth, hypnotism, psychoanalysis, child psychology, rehabilitation of the disabled, social case work, narcotics, alcoholism, rainmaking, space travel, guided missiles, the solar system, microchemistry, fossils, ceramics, and many more.

Unlike more conventional science programs *Science for the People* has consistently exposed misleading advertisements, exaggerated science articles, pseudoscientific books, and the literature of quacks, cultists, and faddists. It has endeavored to provide accurate science news, often including reports of the Federal Trade Commission and the Food and Drug Administration missing in the popular press. Finally, it has attempted, as far as possible, to act as a clearing house for science information by answering questions submitted by listeners. In this respect it has often been able to help people with serious problems who knew not where else to turn.

WEVD has most generously donated the broadcast time. However, during the first 18 months Mr. Rázim financed all other operating expenses from his personal funds. Mr. Rázim also conducted all literature searches, gathered and checked news reports, arranged interviews, prepared scripts, conducted campaigns to publicize the series, answered all correspondence, and even did all the required typing. But in the summer of 1951, Mr. Rázim, faced with a seige of ill health, was forced to seek outside help. To prevent the demise of *Science for the People,* he persuaded a small nucleus of enthusiastic colleagues to join him in establishing a non-profit organization, *Science for the People Foundation.*

This foundation, with membership open to public-spirited scientists, educators, and laymen, has several basic objectives. It is seeking to expand the services of *Science for the People* and eventually to make transcriptions available to other stations throughout the country. It plans to renew attempts to initiate a second program on one of the major networks—hopefully, a television series. It would like to provide on the spot interviews, coverage of all major science conventions, and an adequate question bureau service to listeners. Finally, if funds permit, it hopes to make free literature available to the public and to publish an official organ.

Obviously the success or failure of this organization will depend in part upon the extent to which it can arouse the scientifically trained to contribute (time, money, or both) toward achieving these objectives. And so, perhaps the ultimate history of *Science for the People Foundation* will be of interest to the social scientist as a social experiment.

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Book Reviews

Handbuch der Pflanzenkrankheiten (Sorauer) Bd. VI, 1. Lief.: ***Pflanzenschutz.*** 2nd ed. O. Appel *et al.,* Eds. Berlin-Hamburg: Paul Parey, 1952. 448 pp. DM 78.

This book, the first part of volume VI of the *Handbuch,* is devoted to a presentation of the economic aspects and the problems of plant protection. The companion volume, dealing with control of plant diseases and insect injuries, will appear later. Twelve years have passed since the last revision of this well-known publication. This volume has a table of contents and an extensive index to help the reader in finding any subject of interest. The statements made are conveniently documented by citations to the related literature in footnotes that frequently occupy more space than the text.

The first section, prepared with the cooperation of H. Morstatt, of Berlin-Dahlem, deals with the economic importance of plant protection, and discusses such topics as the kind and extent of damage caused by diseases and insects, the cost of plant-protective measures, results obtained, insurance against crop damage, and the government and plant protection.

The second section, by H. Braun of Bonn, deals

with the problems of plant protection and the measures to be taken, such as the prevention of the appearance of plant diseases and cultural measures, including rotation, selection of seed, time and depth of planting, and spacing of plants. Dr. Braun discusses at length the many problems of soil sterilization, including its applicability and limitations, mechanical measures, and sterilization by means of electricity, heat, and chemicals. All chemicals known to possess soil-sterilizing properties are assessed, brief directions for their use are given, and the organisms controlled are listed.

A third section, by G. Gassner of Braunschweig, is devoted to the treatment of seeds and propagative plant parts. He discusses methods and materials used and their applicability to various kinds of seeds, as well as to tubers, bulbs, and cuttings.

In the final section Dr. Braun deals with the problems concerned with quarantines such as the economic significance of the spread of plant diseases and pests, the purpose of quarantine, the economic and biological bases of quarantines, and the measures that need to be taken to carry them out.

The book is a valuable addition to the literature relating to plant protection.

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Cancer in Man. Sigismund Peller. New York: International Univs. Press, 1952. 556 pp. Illus. $12.00.

Cancer in Man is one of the most provocative and could become one of the most controversial books in the field of oncology. Primarily it is neither a text nor a reference book, but the review of a long career in cancer epidemiology.

The book is purposefully organized and intensely written. It is well indexed and includes an extensive bibliography. Three sections in turn (1) deal with cancer research, (2) lay the foundation for the author's epidemiological solution to the problem of cancer, and (3) present the solution. Part 1 on "Pathology of Human Cancer" includes a well-organized and generally satisfactory review of cellular concepts and histogenesis and the philosophy underlying these concepts. New and old observations have been woven together into a readable and useful summary, which is well annotated to serve as a source book for the advanced student and research worker. Although the author has obviously followed experimental literature carefully, his interpretations of the "outstanding results of experimentation" and "evaluation of the experimental trend" are founded on a philosophy of clinical empiricism and appear rather superficial to the experimentalist. This is reflected in his ultimate rejection of modern cellular and biochemical hypotheses in favor of a modification of the century-old but now almost meaningless irritation theory of Virchow. Although the research worker may rebel at the author's conclusions, he will find in them a powerful stimulus to the much needed self evaluation of his own experimental approach to the cancer problem.

In Part 2, "Epidemiology of Cancer," is a lengthy review designed to support the author's thesis that cancer is an immunizing disease, one kind of which tends to protect the individual against development of a second cancer. Here one finds a curious mixture of speculation, selected statistical data, and the casual rejection of conflicting views. Among the latter, the author discards all concepts of organ specific cancer susceptibility on a hereditary basis as "inconclusive." He is highly critical of the 1937–39 surveys carried out by the Public Health Service in 10 major cities in the U.S., but unfortunately does not refer to the improved surveys in these same cities in 1948–49, although these appeared beginning in 1950—an earlier date than many other papers that he reviewed. The studies by Shields Warren and his associates on the occurrence of multiple cancer are also discounted as inadequately controlled and hence inconclusive.

Part 3 presents Dr. Peller's immediate solution to the cancer problem. Based on acceptance of his foregoing analysis, he contends that a cancer control program can be based on deliberate efforts to encourage the development of skin cancer, which is curable in most cases, and that such cured cancer patients will then usually be immune to development of an internal, highly fatal type of cancer. Such a program would allegedly reduce cancer mortality by approximately 90%.

As a whole, *Cancer in Man* will appeal to few; in parts it will be unacceptable to most people who have directed their efforts toward the solution of this problem. The book is stimulating, but not convincing. Peller's theses of a newer and better cancer control and on the reorganization of research efforts will hardly find better acceptance now than when previously offered.

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Wayne University College of Medicine

Scientific Book Register

The Comets and Their Origin. R. A. Lyttleton. New York: Cambridge Univ. Press, 1953. 173 pp. Illus.+ plates. $5.00.

America's Ancient Civilizations. A Hyatt Verrill and Ruth Verrill. New York: Putnam, 1953. 334 pp. Illus. + plates. $5.00.

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Cacti and Succulents. G. Gilbert Green. New York–London: Pitman, 1953. 238 pp. Illus. + plates. $7.00.

The Common Sense of Science. J. Bronowski. Cambridge, Mass.: Harvard Univ. Press, 1953. 154 pp. $2.00.

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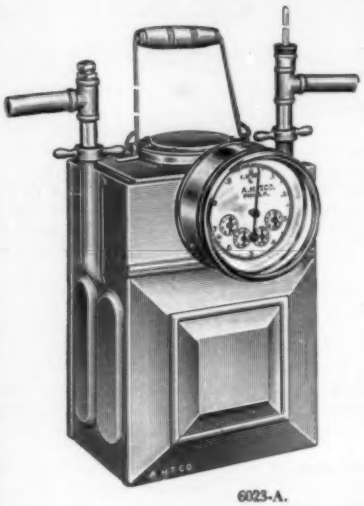

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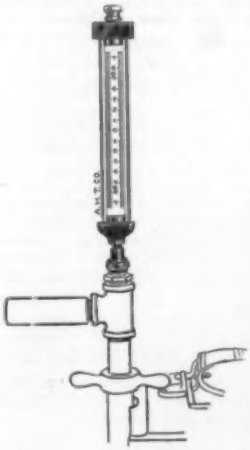

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By Pierre Gourou, College of France. Translated by E. D. Laborde, Harrow School. Ready, July 1953. About 176 pp. Figs. 16 plates. Geography of the tropical regions. About $3.50.

THE RESTLESS ATMOSPHERE

By F. K. Hare, McGill University. (Hutchinson's University Library.) About 175 pp. 40 figs. Weather and climate. Text, $1.80; Trade, $2.40.

THE GEOGRAPHY OF TOWNS

By A. E. Smailes. (Hutchinson's University Library.) Ready, Aug. 1953. About 200 pp. 11 maps. Location and growth of towns. Text, $1.80; Trade, $2.40.

MAPS AND THEIR MAKERS

By G. R. Crone, Librarian of the Royal Geographical Society. (Hutchinson's University Library.) Ready, Aug. 1953. About 180 pp. Figs. The history of cartography. Text, $1.80; Trade, $2.40.

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June 15–20. American Association for the Advancement of Science. Pacific Division. Santa Barbara, Calif.
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June 18–20. American Physical Society. University of Rochester, Rochester, New York.
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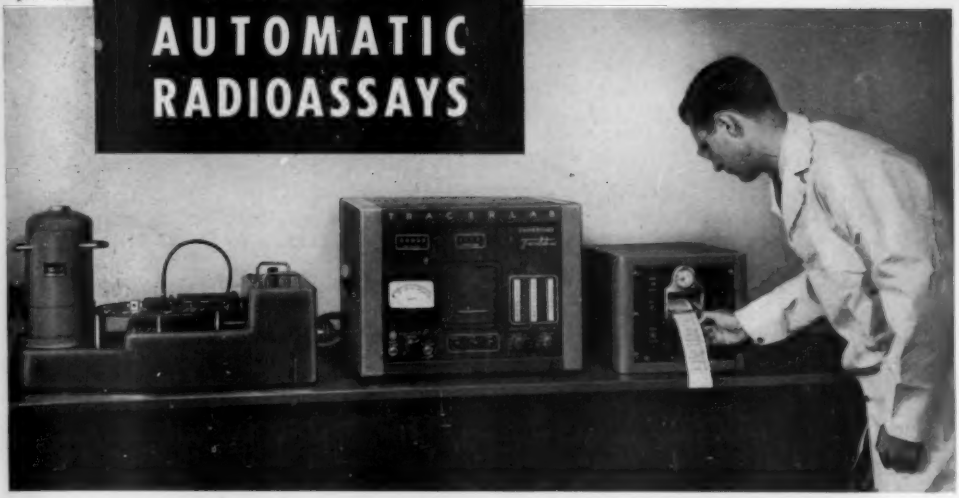

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What General Electric People Are Saying...

RALPH J. CORDINER

President of the
General Electric Company

". . . America is a land of many things, and high on the list are the pioneers. These men who crossed rivers, wrote the first chapter for the occasion that is this Centennial. The responsibility of the scientist, the legislator, the educator, the labor leader, the industrialist, the farmer, and the businessman is to look toward the future. Some people are frightened by it, some are elated, but I believe that a sense-of-the-future can be used to sharpen our senses as to what we are doing and where we are going.

For nearly eight years we have been living in the Atomic Age, whether we like it or not—and there are some who do not like it. But the fact of the matter is, we cannot return to any other Age. Through science, we have drastically changed our environment. Therefore, we must change the manner in which we live to accord with these new conditions. Atomic power promises abundance as readily as desolation—but only on the condition that we welcome and prepare for abundance.

At Washington Territorial Centennial
Olympia, Washington

P. A. ABETTI

Mr. Abetti, a development engineer with GE, is a native of Italy.

". . . For years I have been searching through foreign technical literature, as practically all development engineers do to some extent. But the technical journals of Nazi Germany, Fascist Italy, and prewar Japan, wretched as they were, were still a cut above the present magazines of the Communist or Communist-dominated countries.

This shows clearly that the division of the world into two opposing ideological camps has never been as marked as at the present time; it also shows that engineering, often reputed to be entirely separated from politics, is being drawn more and more into the struggle by the rulers of the Red countries.

G.E. Review

H. A. WINNE

Mr. Winne is Vice President in charge of Engineering

". . . As the average citizen counts his scientific blessings, he carries around in the back of his head a mushroom cloud put there by the memory of Hiroshima, also the gift of science. This is no reason to abandon scientific effort. But it is a reason for us to *clarify* our moral objectives, *face* up to the responsibilities that travel in the wake of technical progress and *win* public understanding.

In this world of uncertainty and fear, the public wants to blame someone, and it is looking squarely at the scientist and the engineer. People are afraid of the hydrogen and the atomic bomb and the possibilities of biological warfare. They tend to move to the faulty conclusion that the men who make such weapons are possibly the villains. They think that perhaps we engineers have at last outsmarted ourselves by planting the seeds of universal destruction.

As I see it, we must correct the false notions the public may have about men of science and engineering and come up with the true significance of scientific progress as it really bears on our destiny as free men. It is important for engineers and scientists to do more than just stand by to be explained and defended.

As engineers and scientists I suggest that we must *improve our human relations* and take note of what the public is saying about us. We must explain the true significance of our work and gain better public understanding.

That will lead to an informed public. And an informed public is necessary to our continued vitality and freedom as engineers and businessmen.

Our future will in a large measure be determined on how well we develop this public understanding to keep pace with our scientific achievements.

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